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The Journal

OF THE

AMERICAN DENTAL ASSOCIATION

Vertical Dimension—*Harper*

Caries Control—*Krasnow et al.*

Immobilization of Fractures—*Logsdon*

Odontoma with Impacted Teeth—*Tanner*

Abrasion of Dentifrices—*Epstein and Tainter*

Gunshot Wounds in Modern Warfare—*Meyer*

Temporomandibular Articulation—*Vaughan*

Anesthesia Under War Conditions—*Archer*

Economic Success in Dentistry—*Sweet*

Lens Grinder of Delft—*Sheppard*

Dental Cementation—*Henschel*

OCTOBER 1, 1943

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A STUDY OF THE TEMPOROMANDIBULAR ARTICULATION

By HOMER CREE VAUGHAN, D.D.S., New York, N. Y.

THE mandibular articulation is a most important medical and dental structure. Aside from its pathologic expressions such as ankylosis and extreme subluxation, its consideration is vital in any complete oral diagnosis. The realization of this has prompted many investigators to study this diarthrodial joint carefully and from different approaches, in order to determine the many agents influencing the joint.

I consider the only basic approach, in order to establish all the dimensional factors involved, to be a study of the gross anatomic features, correlated, if possible, with the oral factors and on a quantitative basis. The records that follow were collected while I was associated with the New York University College of Dentistry, and through the generosity of Prof. Gustave J. Noback, of New York University, in making this material available for study. The work extended over a period of three years; more than seventy-five cadavers being available for observation while complete records of both oral and mandibular joint conditions of more than sixty of the specimens were made.

The method of procedure was to enter the anatomy room before the cadavers were dissected, make a record of the cadaver number and determine the oral condition of each cadaver. Many notes were taken, such as what teeth, if any, were present; whether they showed cusp wear; what the probable chewing habits of the patient were; if edentulous, whether there were any signs that artificial teeth had been worn and, if so, for how long; etc. My purpose was to collect as much information as I could from the prosthetic viewpoint and to see just where this information might lead. Later, during the dissection of the head I collected data on the mandibular joint while making a dimensional study of the temporomandibular articulation. Figure 1 shows the method of charting several of the specimens examined.

In this paper there will be no discussion of the anatomy of the temporomandibular articulation. A general description has been given by others. It

will be my assumption that all are familiar with the usual outlines of the parts involved. However, it is my desire to not only record my observations, but to offer an interpretation with the hope that they will contribute to better understanding of one of our dental problems.

Examination of each cadaver definitely demonstrated that every part of the mandibular articulation is subject to wear regardless of whether all the natural teeth are present or the individual had been completely edentulous and without

I shall begin with a description of the major changes observed in each anatomic member of the articulation and in the following order: the glenoid fossa, the meniscus and the condyle head. Later, I shall correlate these observations so that a dimensional concept related to prosthetic considerations can be obtained. Throughout this correlation, I shall, wherever possible, refer the many compensations to their relations with the head of the condyle.

The glenoid fossa constitutes the

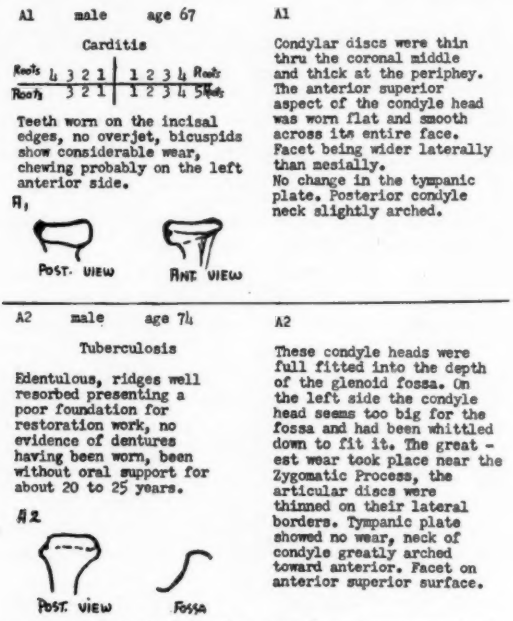

A1 male age 67
Carditis
Roots 4 3 2 1 | 1 2 3 4 Roots
Roots 3 2 1 | 1 2 3 4 5 Roots
Teeth worn on the incisal edges, no overjet, bicuspids show considerable wear, chewing probably on the left anterior side.
A1
POST. VIEW
ANT. VIEW
A1
Condylar discs were thin thru the coronal middle and thick at the periphey. The anterior superior aspect of the condyle head was worn flat and smooth across its entire face. Facet being wider laterally than mesially.
No change in the tympanic plate. Posterior condyle neck slightly arched.
A2 male age 74
Tuberculosis
Edentulous, ridges well resorbed presenting a poor foundation for restoration work, no evidence of dentures having been worn, been without oral support for about 20 to 25 years.
A2
POST. VIEW
FOSSA
A2
These condyle heads were full fitted into the depth of the glenoid fossa. On the left side the condyle head seems too big for the fossa and had been whittled down to fit it. The greatest wear took place near the Zygomatic Process, the articular discs were thinned on their lateral borders. Tympanic plate showed no wear, neck of condyle greatly arched toward anterior. Facet on anterior superior surface.

Fig. 1.—Method of charting several specimens examined.

the benefit of prosthetic appliances. Each articulation presented as much variation as the facial characteristics of the cadavers. It is important to adopt a more fluid concept of the mandibular articulation, since we too often view this articulation as parallel to that found on a mechanical articulator. In general, the mandibular joint presents the phenomenon of continuous reduction of its constituents with an increase in their working area.

cradle in which this joint operates. It brings the mandibular articulation in relation to many interesting anatomic areas of the head and neck, such as the temporal lobe of the brain, the meningeal artery and dura, the cartilage of the outer ear, the fifth and seventh nerve and their accessory nerve fibers and the branch of the parasympathetic system operating through the area of the seventh nerve. The joint is designed and placed

so that its compensations will produce the minimum of harm to other surrounding structures.

Among the facts observed were: The fossae always faced what would be considered the major pull of the external pterygoid muscles and directly toward the infratemporal fossae and the origin of the external pterygoid muscles. In the direction of a frontal plane, and measured with the midsagittal plane, the fossae may vary as much as 15 to 20 degrees in the same head. (Fig. 2.) In viewing the inferior aspect and capsular outline of a fossa, it suggests a partially inflated balloon when held by its spout, representing the anterior aspect; and flattened on one side, representing the inferior aspect. (Fig. 3.) The eminentia articularis very often acts as a guide in this age group. It frequently becomes sharply grooved to a depth of 4 mm., which means that as the condyles tilt forward and down, their lateral surfaces can butt against a wall of more than 50 degrees, compared to a horizontal plane from the base of the nose to the inferior edge of the auditory canal.

The coronal plane of the eminentia very often presents a steeply inclined surface. In these specimens, the horizontal phases of the articular eminences were small, about one-third centimeter. But most often, in this age group, the fossae were shallow. In these specimens, the horizontal phase of the articular eminences was more than 1 cm. When all the teeth were present in these specimens, it was difficult to ascribe any deflection of the fossae to their presence

Fig. 2.—1, fossae, which, in direction of frontal plane and measured with midsagittal plane, may vary as much as 15 to 20 degrees in same head. 2, horizontal superior fasciculi. 3, vertical or inferior fasciculi, showing direction of pull of external pterygoid muscle.

except for the fact that the fossae presented sharper areas of compensation.

The superior portion of the fossae does not correspond to the shape of the condyle head. In approximately 30 per cent of the cases observed, the reshaping of the glenoid fossae occurred in such a manner as to bring the condyle head very close to the temporal lobe of the brain. In these cases, the superior wall of the glenoid fossae had changed to an area of fibrocartilage. At its thinnest section, the area measured from 1 to 3 mm. When held to the light, it was translucent. The

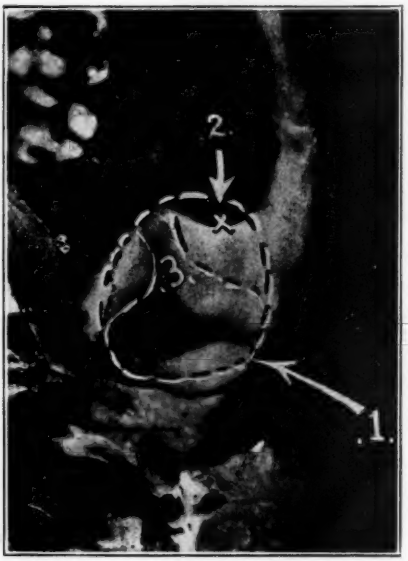


Fig. 3.—Inferior aspect and capsular outline of fossa, suggesting partially inflated balloon when held by its spout; representing anterior aspect, and, flattened on one side, representing inferior aspect. Arrow 2 indicates the point of impingement on the temporal muscle.

weight of a dull probe was all that was necessary to make a puncture into the cranial cavity. This occurred regardless of the presence or absence of teeth and sometimes unilaterally. This thinning of the glenoid fossae brings the action of the condyle head just posterior to a recognized auditosensory and auditopsychic area. It is probable that the pressure of the working condyle head causes a bulging of this fibrocartilage, which in turn causes a light pressure of a stimulating nature on the temporal lobe. These observations show that all bony contact is with the squamous portion of the temporal bone. At no time did I observe any change of the tympanic plate which might be ascribed to the action of the condyle head.

The meniscus, a tough fibrocartilaginous disk, showed a variety of changes. Whenever all or a number of teeth were present, the thinnest portion was through the coronal middle. The next thinnest area was the lateral one-third of the disk, that portion articulating between the outer ledge of the condyle and the base of the zygomatic arch. In approximately 17 per cent of these cases, the anterior border was thinned and appeared ragged.

Fig. 4.—Probable normal direction of wear through sagittal middle in these age limits—45 to 85.

It is along this anterior border of the meniscus that we find an explanation for some of the tenderness noted clinically. Here, the superior fasciculi of the external pterygoid muscles are attached. The friction and tearing which obviously take place could give rise to pain. This study points to the fact that the meniscus frequently does not have the same anterior range as the condyle head. Apparently, the fibers that attach the meniscus to the posterior wall of the capsular ligaments limit its movement anteriorly and rotationally to a range less than that through which the condyle head can move. Its function seems to be to reduce friction and act mechanically as a "shim" or take-up mechanism to aid in stabilizing the con-

dyle head in eccentric movements. Realizing that what is normal for the meniscus has never been determined, it is of interest to note that, in edentulous cases of long standing, the meniscus presented the least change in form.

A most important guide in the study of mandibular function is the head of the condyle. Here, the greatest degree of compensation takes place. The specimens ranged in area from 1.5 cm. to virtually no condyle at all. They showed that the condyle undergoes continual reduction in size throughout life. However, in all these cases, the primary articulating facet rior portion of the condyle head, to the extent of bringing the lateral aspect of the condyle flush or well inside of the lateral aspect of the ramus. This occurred in about 54 per cent of these cases. Where teeth were present, the sharpness of the wear was emphasized. Figure 5 shows six left condyle heads taken at random, with sketched outlines to aid in a better interpretation. This demonstrates the variableness of condylar form and the nature of its compensation. It is important to consider that the posterior fibers of the capsular ligament (Figs. 2 and 4) run almost vertically

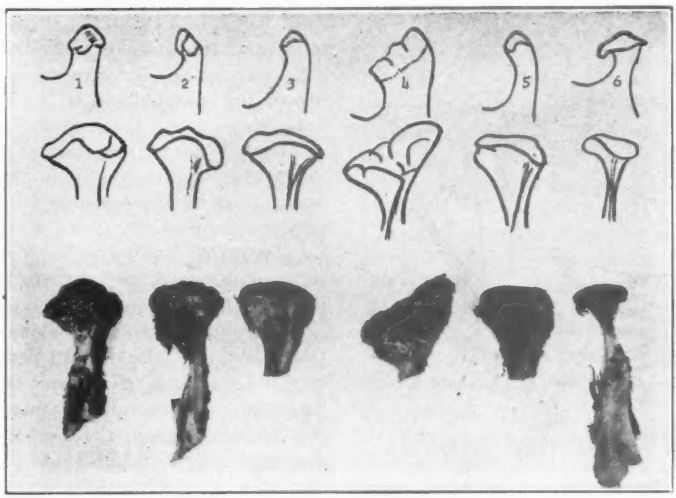


Fig. 5.—Six left condyle heads taken at random with sketched outlines to aid in better interpretation.

maintained a position on the anterior-superior aspect of the condyle head. Figure 4 shows the probable direction of wear through the sagittal middle in these age limits. Among the anterior limiting factors in a forward glide or tilt of the condyles in shallow fossae are the posterior fibers of the temporal muscle. Impingement on these fibers will give rise to some tenderness. Aside from this overall reduction, the next most common area of wear is the lateral anterior-superior with full condyle heads and incline slightly toward the anterior aspect with considerable wear. The anterior fibers of the capsular ligament are horizontal, in line with the muscle pull of the external pterygoid muscle, which indicates that the external muscles act as tensors for the capsular ligament. (Tensor action is a state of moderate muscle contraction having a tightening effect on the temporomandibular articulation and serving the primary purpose of keeping the va-

rious members of the joint in close apposition.)

This study shows that primarily through the action of the external pterygoid muscles, the condyle head is subjected to a continuous anterior pull, varying in degree, throughout life. The reasons for this conclusion are:

1. The primary articulating facets on the condyle heads were always located on the anterior aspect.

2. The glenoid fossae, when deep, were reshaped with wearing facets only on their anterior walls *(eminentia articularis)*.

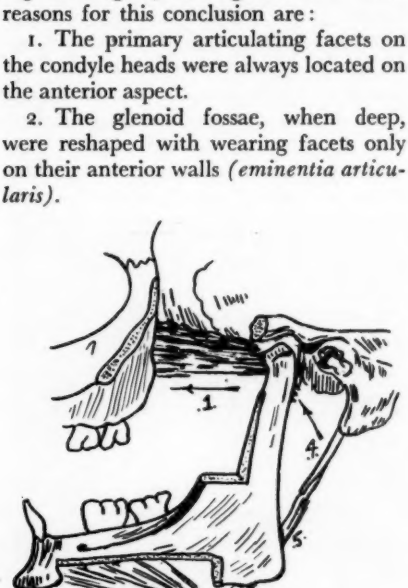


Fig. 6.—Schematic drawing showing muscle forces responsible for forward tilt of mandible. 1, external pterygoid muscle. 2, direction of chin movement. 3, direction of pull of suprahyoid musculature. 4, posterior fibers of capsule. 5, direction of pull of muscles that stabilize hyoid cartilage.

3. When the glenoid fossae were shallow, the horizontal portion of the *eminentia articularis* always showed a broad articulating plateau (inverse proportion).

4. When reshaping of the glenoid fossae occurred to a great degree, the fossae became thinned to transparency. This could occur only by moving away from the petrosal portion of the temporal bone (anteriorly).

5. The posterior edge of the meniscus showed the least amount of change. Its anterior and lateral edges were most frequently thinned.

6. The drift of the inferior border of the posterior fibers of the capsular ligaments is anterior.

7. The petrotympanic fissures were never found closed or otherwise changed through any action that might be ascribed to movement of the condyle head.

8. No articulating facet was ever found on the tympanic plate.

Contrary to the belief that the condyle head is displaced distally, there is every indication that the reverse takes place. This study shows the natural repositioning of the mandible to be forward and upward.

There is every indication that the movement of the mandible downward is an act of tilting performed essentially between the posterior fibers of the capsular ligament, acting as a hinge; the anterior forward pull of the external pterygoid muscles in the direction of the maxillary tuberosity acting along with the posterior pull of the muscles between the symphysis of the chin and the hyoid cartilage (the suprahyoid muscles and the muscles which stabilize the hyoid cartilage. (Fig. 6.) This study shows that the attachments of the external pterygoid muscles are superior to the attachments of the posterior capsular fibers to the posterior border of the ramus.

The study of this one movement serves to illustrate several conditions:

1. The voluntary muscles controlling the mandible serve a twofold purpose. They act through contraction to move the part and they also act as tensors serving to stabilize the various gyrations of the mandible. With the downward movement of the mandible, the internal pterygoids, normally considered as elevators, act as voluntary tensors for this rotation.

2. The axis of rotation for a downward movement of the mandible will probably be found at the junction of the inferior border of the posterior capsular fibers with the ramus of the mandible.

3. This is a flexible fulcrum subjected to varying voluntary degrees of tensor action, which will permit mandibular gyrations from which a variety of mathematical centers can be projected; limited only through the restrictions incurred by the anatomic structure of the parts.

Present-day literature refers to traumatic injury to the middle ear, pressure on the chorda tympani and involvement of the eustachian tubes as controlled by repositioning of the mandible with prosthetic appliances. It is important to emphasize that it would be extremely difficult to demonstrate such relation possibilities through anatomic dissection, study and observation. Most prosthodontists have experienced definite improvement with our procedure in repositioning the mandible and balancing the occlusion. In the light of this study, it is my opinion that we affect the function of the temporomandibular joint very little. What we probably do is to improve the conditions which control the epicritic sensibilities (sensations of difference in pressure, temperature, etc.), and improve the proprioceptive reflexes emanating primarily from the voluntary muscles which control the mandible (muscle sensibility). During the long process of natural repositioning of the mandible, the muscles, teeth and supporting structures are forced into strained and unusual positions, which have complicated reactions uncomfortable to the patient, especially when their attention is so directed.

The natural mandibular articular process is a very complex mechanism. An understanding of its changes and nature should be included in prosthetic dental study. The fact that the various movements of the mandible are controlled through voluntary action has not been stressed enough. Limitations based on the anatomic structure of the part, habit, variation of pressure, pain and tenderness, the presence or absence of teeth, the nature of the diet, the density and health of the bony structure, the age, the disposition and the history of the oral changes all must be considered.

The study of the actions and nature of masticatory muscles is still in a relatively undeveloped stage. The use of the adaptable articulator, all important as it is, has had a tendency to direct thought away from the actual structure of the parts involved.

CONCLUSIONS

1. The temporomandibular joint changes continually throughout life, undergoing a continual reduction of its parts with an increase in their working area.

2. The external pterygoid muscles act as tensors for the capsular ligaments.

3. The posterior fibers of the capsular ligaments are vertical; the anterior fibers, horizontal.

4. The head of the condyle (articulating facet) is subjected to a continuous anterior pull throughout life.

5. The anterior range of the meniscus is, in some cases, not so great as the anterior range of the condyle head.

6. Pain can arise from a tearing of the external pterygoid fibers and pressure against the posterior border of the temporal muscle.

7. The natural repositioning of the mandible is forward and upward.

8. The downward movement of the mandible is essentially a tilting act.

9. The axis of rotation for a downward tilt of the mandible will probably be found at the junction of the posterior capsular ligaments with the ramus.

400 Madison Avenue.

DENTAL CARIES CONTROL WITHIN OUR REACH

FRANCES KRASNOW, Ph.D.; EDITH B. OBLATT, A.B., and SYLVIA FRIEDSON, A.B., New York, N. Y.

THIS presentation is a résumé of experience with efforts to prevent dental caries. It includes a summary of biochemical findings in the course of the study and outlines hypotheses based on the assembled data.

The program for the study was based, in part, on certain clinical results suggesting the probable value of a biochemical rather than a purely bacteriologic approach; in part, on the refinements of biochemical investigative methods of recent years.

The light on the horizon has been creeping up slowly. In the twenties, biochemical micromethods were just coming to the fore. These years constitute the decade of studies on calcium-phosphorus levels during bone growth,[1, 2, 3] and on rickets and tetany,[4-8] not possible before the discovery of how to make determinations on 1 or 2 milliliter samples.[9, 10] Since similar simple, easily duplicated and expeditious procedures for testing other blood constituents were quickly being evolved, blood examination was adopted as a diagnostic aid in tests regarding protein, carbohydrate and lipid metabolism,[11-15] as well as inorganic exchange. Hitherto, not only did quantitative analysis necessitate large specimens,[16, 17] but also the methods were too time consuming for multiple check and recheck. Recent indeed are the beginnings of our now well-established hospital laboratory routine.

Perhaps there should be no wonder, then, that estimations of like nature having a distinctly dental import were fewer and not of such variety.[18-22] References to biochemical needs for tooth health were only occasional.[23, 24] As the thirties approached, a definite stand in this regard was attempted, but was generally not achieved, despite claims of success in the management of dental disease.[25, 26, 27] About this time, although there seemed to be general acceptance of theories regarding dental caries based on chemicobacterial action taking place on the tooth surface, various groups began seriously to question the complete validity of this concept. Attention was focused on the problem, with extension of the purely bacteriologic phase into the realm of biochemistry, stressing general metabolism. Investigators working under the aegis of such institutions as the British Medical Research Council, Columbia University, Forsyth Dental Infirmary, Guggenheim Dental Clinic, Iowa State University, Michigan State College, University of Michigan, Oslo Dental School *(Norges Tannlaegehoiskole)*, University of Toronto and United States Public Health Service have made contributions to the newer knowledge of dental caries. The hypothesis herein presented—dental caries control within our reach—stems from perusal of data accumulated at the Guggenheim Dental Clinic over approximately ten years on children between 2 and 16 years selected from registrants there, as well as on patients of various ages referred for consultation by other institutions and private practitioners.

Distinct chemical pictures were recog-

From the Murry and Leonie Guggenheim Dental Clinic.

nized for various oral manifestations, differing in number of salivary constituents divergent from the normal. Average values presented in Table 1 are graphically alined below (Fig. 1) to indicate degree of non-randomness.

Two points are clear: 1. When saliva is alkaline, fewer components assume abnormal levels than when it is acid. 2. There is less aberration in caries involvement than in erosion.

Changes apparently follow a uniform pattern, thus far thrice corroborated. The accentuation of derangement associated with erosion was interpreted to indicate the possibility of damaging cumulative effects. This theory is entirely tenable if importance is attributed to the

TABLE 1.—AVERAGE VALUES FOR ANALYSES ON TOTAL UNSTIMULATED SALIVA

Analyses*	Involvement				
	None†	Caries		Erosion¶	
		Acid	Basic	Acid	Basic
pH	7.14±0.04	6.92±0.06	7.24±0.04	6.83±0.05	7.19±0.07
Calcium	6.3±0.4‡	6.2 ±0.2	6.0 ±0.25	7.6 ±0.5	5.5 ±0.5
Magnesium	0.46±0.07	0.65±0.6	0.63±0.06	0.75±0.1	0.42±0.04
Inorganic phosphate	15.2± 1	14.4±0.6	12.6±0.7	18.0±1.4	12.2±1.6
Protein	298 ±17	346 ±24	315 ±33	446 ±46	284 ±33
Lipid phosphorus	0.13±0.02	0.20±0.03	0.19±0.02	0.52±0.11	0.26±0.11
Cholesterol	7.5 ±0.7	10.7±0.77	9.2 ±0.7	11.2±2.0	5.3 ±2.1

*The quantitative procedures are described in references 29-34.
†All figures except those for pH are in milligrams per hundred milliliters.
‡Cases judged free of abnormality by medical, dental and laboratory examination.
¶Erosion—wasting—abrasion.

TABLE 2.—SALIVARY MAGNESIUM ANALYSES ON TOTAL UNSTIMULATED SALIVA

Case Type	Number of Cases	Average Range*	Odds Against Random Deviations†	Percentage Above Average Normal Range
Caries-free				
Without systemic involvement	15	0.37±0.03		
With systemic involvement	12	0.41±0.05	1	50
Caries-active				
Without systemic involvement	92	0.54±0.03	175	67
With systemic involvement	39	0.58±0.06	31	65

*Milligrams per hundred milliliters
†Based on D:P.E.

higher age interval, ranging from 7 to 65 years for the erosion cases, as compared with a span of 3 to 35 for the decay series.

ailments uncomplicated by dental abnormality caused the salivary divergencies just characterized. The conditions met with were common colds, canker

TABLE 3.—SALIVARY PROTEIN ANALYSES ON TOTAL UNSTIMULATED SALIVA

Case Type	Number of Cases	Average Range*	Odds Against Random Deviations†	Percentage Above Average Normal Range
Caries-free				
Without systemic involvement	21	283±12		
With systemic involvement	12	329±34	2	33
Caries-active				
Without systemic involvement	111	353±11	267	67
With systemic involvement	41	384±20	267	71

*Milligrams per hundred milliliters.
†Based on D:P.E.

TABLE 4.—EVALUATION OF WEEKLY DIETARY RECORDS

Case Type	Number	Age Range	Ratio Between Average Daily Portions of Fruit-Vegetable Foods and Non-Fruit, Non-Vegetable (Percentage)							Milk Daily Average Portions (Percentage)			Water Daily Average Portions (Percentage)		
			>2:1	2:1	Between 2:1 and 1:1	1:1	Between 1:1 and 1:2	Between 1:2 and 1:3	<1:3	Below Minimum	Minimum*	Above Minimum	Below Minimum	Minimum†	Above Minimum
Caries-free	28	3-20	0	0	17.8	10.7	53.5	14.2	3.5	50.0	7.1	42.8	91.6	4.1	4.1
Caries-active	220	3-35	0.9	1.4	17.7	5.5	60.9	10.5	3.2	61.2	6.5	32.2	90.5	0.9	8.4
Students not classified	160	17-28	3.7	0.6	28.7	6.3	50.6	10.0	0	75.0	6.9	18.1	70.0	6.3	23.7

*Approved minimum of milk: child, 3 glasses daily; adult, 2 glasses daily.
†Approved minimum of water: through 10 years, 5 glasses daily; 11 years and over, 6 glasses daily.

Thought in this direction was stimulated when analyses summarized as in Tables 2 and 3 indicated that systemic

sores, nervous irritability and early chorea. Furthermore, systemic malfunction superimposed on dental trouble

tended to increase the deviation. Note here the gradients between the pairs of figures: for magnesium: 0.37 ± 0.03 to 0.41 ± 0.05; 0.41 ± 0.05 to 0.54 ± 0.03 and 0.54 ± 0.03 to 0.58 ± 0.06, and, more strikingly, for protein: 283 ± 12 to 329 ± 34, 329 ± 34 to 353 ± 11 and 353 ± 11 to 384 ± 20. It would be difficult, for example, to differentiate a case giving results of 329 ± 34 for the caries-free case with systemic trouble from one showing 353 ± 11 for the caries-active without other malady.

Although later work contributed in addition to the rôle that inorganic substances play in the complete salivary picture, it established also the occurrence of marked fluctuations in the protein and lipid fractions. These findings tended to shift some emphasis to the organic salivary constituents. Scrutiny of the high levels indicated a close tally with the rise obtained for corresponding blood constituents in infections and inflammations,[36, 37, 38] marked activity,[39, 40, 41] pregnancy[42] or diabetes.[36]

That acidic states may accompany each of these conditions threw light on the probability of a syndrome relating dental decay to derangement in metabolism, the apparent importance of local oral factors notwithstanding. Wherein lie the metabolic shortcomings? An examination of nutrients as a possible starting point for the imbalance of positive and negative ions seemed a promising approach to solution. Thus, comparative calculations for 408 weekly dietary records were made. The detailed figures of Table 4 are diagrammed in Figure 2.

More than 70 per cent show low intake of protective and regulatory foods—milk, fruits and vegetables—and water. Even the caries-free cases show this tendency except possibly for taking more milk. The student group shows somewhat higher intake of fruit, vegetables and water. Fish oils practically did not appear even in reports from individuals of higher income. The compilation may be construed as a habit cross-section of a mixed population. Ages ranged from 3 to 35 years, the large majority below 20. The economic stratum varied from that of the poorest clinic case to that of the

TABLE 5.—CALCIUM AND MAGNESIUM CONTENT OF FOODS

Potentially Acid Foods				Potentially Basic Foods			
Food Edible Portion	Per Cent		Ml. Normal Acid per 100 Gm.	Food Edible Portion	Per Cent		Ml. Normal Base per 100 Gm.
	Calcium	Magnesium			Calcium	Magnesium	
Barley	0.020	0.060	10	Apples	0.007	0.008	3
Beef (lean)	0.013	0.024	12	Bananas	0.008	0.030	8
Cocoa	0.112	0.420		Beans (dried)	0.148	0.158	10
Corn	0.029	0.121	1.8	Beets (fresh)	0.028	0.026	10
Eggs	0.063	0.010	11	Cabbage	0.046	0.012	6
Oatmeal	0.065	0.122	12	Carrots	0.045	0.020	14
Peanuts	0.067	0.180	3	Oranges	0.024	0.011	5
Rice	0.011	0.033	9	Potatoes	0.013	0.028	9
Rye	0.061	0.155		Tomatoes	0.011	0.013	5
Wheat (entire)	0.053	0.133	12	Turnips	0.056	0.018	11

TABLE 6.—SAMPLE MENU FOR FIVE-YEAR-OLD CHILD: DETAILED ANALYSIS OF INORGANIC INTAKE

Time	Foods	Portion	Calories	Gm. Water	Grams										Excess Milliliters	
					Potassium	Sodium	Calcium	Magnesium	Iron	Copper	Manganese	Chlorine	Sulfur	Phosphorus	Normal Acid	Normal Base
Upon rising	Water	1 cup		227												
Breakfast	Cod liver oil	1 tsp.	50													
	Cereal, oatmeal	⅓ cup*	50	75	0.043	0.008	0.009	0.014	0.0005	0.0001	0.00062	0.009	0.025	0.049	2.0	
	Evaporated milk	¼ cup	85	106	0.175	0.062	0.146	0.015	0.0003			0.129	0.042	0.114		2.6
	Molasses	2 tsp.	30	3	0.134	0.002	0.021	0.007	0.0007	0.0002		0.031	0.013	0.004		6.0
	Milk	1 cup	170	212	0.349	0.124	0.293	0.029	0.0006	0.0001	0.00001	0.259	0.083	0.227		5.1
Mid morning	Carrot	1 medium	35	54	0.204	0.072	0.040	0.015	0.0005	0.0001	0.00018	0.026	0.016	0.033		9.6
	Water	1 cup		227												
Lunch	Greens	½ cup	12	42	0.129	0.012	0.027	0.021	0.0006	†	0.00020	0.022	0.018	0.016		5.8
	Potato	1 medium	100	64	0.362	0.018	0.012	0.024	0.0009	0.0001	0.00018	0.032	0.026	0.049		7.1
	Butter	1 pat	50	1	0.001	0.067	0.001	†				0.103	0.001	0.001		
	Bread, whole grain	1 slice	70	10	0.058	0.110	0.014	0.014	0.0004			0.170	0.034	0.049	2.2	
	Fruit	1 medium	87	106	0.280	0.022	0.029	0.019	0.0006	0.0001	0.00026	0.047	0.022	0.026		7.6
	Water	1 cup		227												
Afternoon	Milk	1 cup	170	212	0.349	0.124	0.293	0.029	0.0006	0.0001	0.00001	0.259	0.083	0.227		5.1
	Bread, whole grain	1 slice	70	10	0.058	0.110	0.014	0.014	0.0004			0.170	0.034	0.049	2.2	
	Butter	1 pat	50	1	0.001	0.067	0.001	†				0.103	0.001	0.001		
	Water	1 cup		227												

Dinner	Split pea soup	½ cup*	79	57	0.199	0.023	0.019	0.033	0.0013	0.0002	0.00044	0.008	0.048	0.088		1.6
	Evaporated milk	½ cup	42	53	0.087	0.031	0.073	0.007	0.0001			0.065	0.021	0.057		1.3
	Turnip	½ cup	16	34	0.154	0.025	0.029	0.008	0.0002	†	0.00004	0.019	0.030	0.021		7.7
	Bread, whole grain	2 slices	140	20	0.106	0.221	0.028	0.028	0.0008			0.340	0.067	0.098	4.4	
	Butter	1 pat	50	1	0.001	0.067	0.001	†				0.103	0.001	0.001		
	Egg‡	1	70	39	0.074	0.076	0.036	0.006	0.0016	0.0001	0.00002	0.156	0.103	0.095	5.5	
	Fruit (apple)	1 medium	80	107	0.161	0.014	0.009	0.010	0.0005	0.0001	0.00011	0.006	0.008	0.015		4.8
	Water	1 cup		227												
Total			1,506	2,343	2.924	1.256	1.094	0.293	0.0106	0.0013	0.00207	2.055	0.672	1.222	16.3	64.3
NRC¶ Values			1,600				1.0		0.008							

*Figures are for uncooked oats and peas.
†Too low for decimal places allowed here.
‡Substituted for by 2.5 ounces meat or fish, or 2 slices whole-grain bread, each once weekly.
¶National Research Council.

well-to-do patient. Intelligence and education levels likewise lay between the two extremes.

Implications of the findings may perhaps be best recognized by comparison of the few usual foods listed in Table 5. Witness the diversity in calcium-magnesium values between meat, fish and cereals on the one hand and apples, oranges, beets and carrots on the other. Diets in which the potential base: acid ratio is less than 1 necessarily contain increased amounts of magnesium. In the organism, this element may replace calcium to a greater or lesser degree. Where it is being laid down rapidly, especially with high intake under acidic conditions and with calcium intake low owing to low milk or vitamin D consumption or both, calcium may go into solution to keep the ion concentration of the circulating fluids at the optimum as long as possible. This may explain why the salivary calcium does not drop too much, despite reduced ingestion or faulty assimilation. Magnesium, however, taken in superabundance, will be constantly at a high level in all tissues and also in saliva. (Table 1.)

To test the feasibility of obviating these shortcomings, nutrition regulation was instituted, involving complete medical, dental and laboratory examinations controlling qualitatively and quantitatively the seven food classes, with stress also on positive ion potentiality, in addition to other usual daily physiologic needs. Progressive alterability of requirements in a family group, overcoming ingrained habits, market availability of recommended foods and rising prices were problems at the outset. Nevertheless, continued experimentation dispersed the difficulties. Daily menus for the 1, 5, 10 and 15 year old children, woman in late pregnancy and man have finally evolved.

Those for the 5 year old are reproduced in Tables 6 and 7. The foods have been broken down into their inorganic and

TABLE 7.—SAMPLE MENU FOR FIVE-YEAR-OLD CHILD: DETAILED ANALYSIS OF ORGANIC INTAKE

Time	Foods	Portion	Calories	Grams			Grams of Fiber Roughage Foods	Vitamins					
				Carbohydrates	Fat	Protein		A IU†	B_1 Mg.	B_2† Mg.	Nicotinic Acid Mg.	C Mg.	D IU
Upon rising	Water	1 cup											
Breakfast	Cod liver oil	1 tsp.	50		5.70			8,027					1,068
	Cereal, oatmeal	⅛ cup*	50	8.30	0.92	2.08	0.13	Trace	0.07	0.01	0.54		
	Evaporated milk	¼ cup	85	6.12	4.98	4.30		272	0.03	0.25	0.09	0.8	2
	Molasses	2 tsp.	30	6.85		0.23	0.18						
	Milk	1 cup	170	11.78	9.76	8.30		427	0.15	0.55	0.17	3.1	5
Mid morning	Carrot	1 medium	35	7.25	0.31	0.78	0.78	1,449	0.04	0.04	0.35	3.6	
	Water	1 cup											
Lunch	Greens	½ cup	12	2.02	0.15	0.70	0.40	902	0.03	0.09		18.0	
	Potato	1 medium	100	15.62	0.08	1.87	0.34	26	0.10	0.04	1.70	10.6	
	Butter	1 pat	50		7.22	0.06	0.34	204					7
	Bread, whole seed	1 slice	70	14.90	0.30	2.90	0.34	Trace	0.08	0.02	0.84		
	Fruit	1 medium	87	18.68	0.51	1.07	1.27	235	0.08	0.05		28.9	
	Water	1 cup											
Afternoon	Milk	1 cup	170	11.78	9.76	8.30		427	0.15	0.55	0.17	3.1	5
	Bread, whole seed	1 slice	70	14.90	0.30	2.90	0.34	Trace	0.08	0.02	0.84		
	Butter	1 pat	50		7.22	0.06		204					7
	Water	1 cup											
Dinner	Split pea soup	¼ cup*	79	13.65	0.24	5.43	0.39	263	0.11	0.07	1.24		
	Evaporated milk	⅛ cup	42	3.04	2.49	2.15		136	0.02	0.13	0.04	0.4	1
	Turnip	⅓ cup	16	3.22	0.09	0.50	0.50		0.02	0.02	0.23	13.6	
	Bread, whole seed	2 slices	140	29.80	0.60	5.80	0.68	Trace	0.17	0.05	1.68		
	Butter	1 pat	50		7.22	0.06		204					7
	Egg‡	1	70		5.62	7.10	0.96	530	0.08	0.17	0.05		
	Fruit (apple)	1 medium	80	17.03	0.64	0.51	1.63	95	0.06	0.04	3.23	6.4	
	Water	1 cup											
Total			1,506	184.94	64.11	55.10	7.76	13,401	1.30	2.10	14.55	88.3	1,102
				49.1%	38.3%	14.6%							
NRC Values ¶			1,600			50.0		2,500	0.80	1.2	8	50	400–800

*Figures are for uncooked oats and peas. †IU, International Units.
‡Substituted for by 2.5 ounces meat or fish, or 2 slices whole-grain bread, each once weekly.
¶ National Research Council.

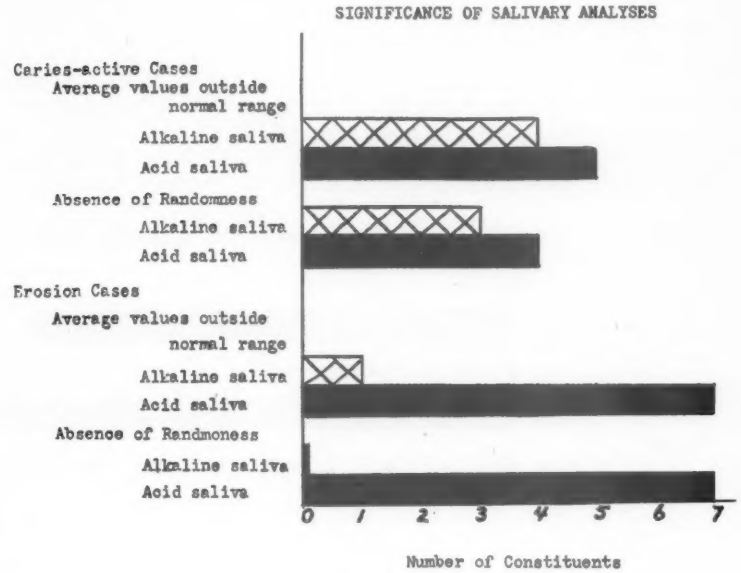
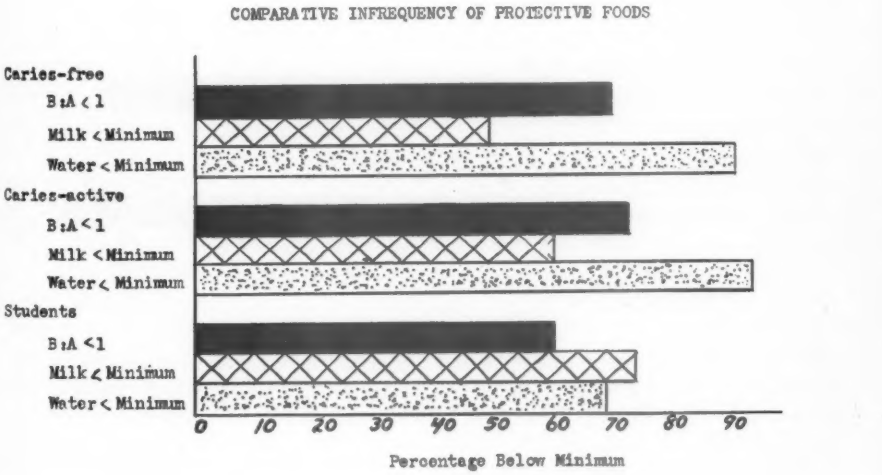


Figure 1.



B Fruits, vegetables
A Non-fruit, non-vegetable

Figure 2.

*Figures are for uncooked oats and peas. †IU, International Units.
‡Substituted for by 2.5 ounces meat or fish, or 2 slices whole-grain bread, each once weekly.
¶ National Research Council.

organic constituents. Calculations were made from analytic data.[36, 43-48]

In all menus, the goal set by the National Nutrition Conference[49] is generally satisfied. Caloric levels have thus far not been raised because need for the higher values has come to our attention only infrequently, as may be deduced from Table 8 and, furthermore, when expenditure is a consideration, it is deemed wise to limit calories as long as other principles are safeguarded. Cod-liver oil as the vitamin D source is recorded as the average of four brands with units per gram varying from 85 to 350. Fish oil is the surest source and, once the child has been trained through the infancy period, would not introduce any educational problem if its use were not interrupted. When lay judgment is far enough advanced and certainty as to dosage fixed, fortified food products might be substituted and perhaps lower the outlay by approximately 2 to 4 per cent of the total daily food cost in inverse relation to age needs. Inclusion of fish oils makes the vitamin A allotments exceed the aim of the National Research Council.[49] Figures for fruits and greens are averages of the usual ones in season, available in apples, oranges and bananas and beet greens, cabbage and lettuce.

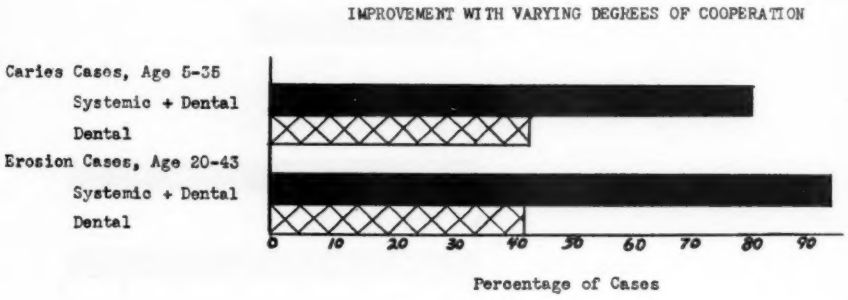


Figure 3.

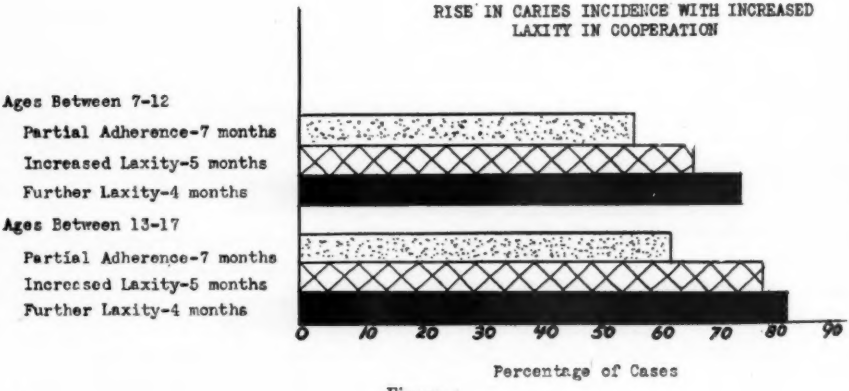

RISE IN CARIES INCIDENCE WITH INCREASED LAXITY IN COOPERATION
Ages Between 7-12
Partial Adherence-7 months
Increased Laxity-5 months
Further Laxity-4 months
Ages Between 13-17
Partial Adherence-7 months
Increased Laxity-5 months
Further Laxity-4 months
0 10 20 30 40 50 60 70 80 90
Percentage of Cases

Figure 4.

Ready comparison is simplified by Tables 6 and 7.

The mechanics of our program, as detailed later, is within every one's grasp. Maneuvering is necessary in realining the concepts regarding substitution of food within classes. Especially is it necessary to counteract the common tendency with regard to the substitution of such foods as macaroni, spaghetti and rice for potatoes, carrots, turnips; raw fruits and vegetables for cooked ones; beet, turnip and carrot tops, usually discarded, for spinach, water cress and chard. To cope with the situation, foods were regrouped as (1) fruits-vegetables, (2) solid non-fruits, non-vegetables—meats, fish, eggs, cheese and grain products including rice and corn, (3) milk and its equivalents — buttermilk or skimmed milk, and (4) fish oil and (5) water.

Upon completion of history records of cases studied at the Clinic (Tables 9 and 10) for dental, medical and laboratory examinations, patients or guardians are supplied with specifically itemized prescriptions deduced from them. (Table 11.) Instructions are personally explained. The psychologic approach to introducing any need for change is to emphasize (1) the good points in the patient's habitual routine; (2) the slight variation that would improve health generally in addition to safeguarding the teeth, and (3) the low cost and ease of preparing the recommended foods. A daily menu following the form in Table 18 is formulated for each case, the aim being to attain the nutrient allotments already outlined in Tables 6 and 7.

TABLE 8.—CALORIC INTAKE AT DIFFERENT AGES

Case Type	Number of Cases	Age Years	Sex	Caloric Intake		
				Case History	Sample Menu Presented	National Research Council Values
Caries-free	11	4-6	♂ and ♀	1358	1506	1600
	9	7-9	♂ and ♀	1514		2000
	4	10-12	♂ and ♀	1418	1732	2500
	1	16-20	♀	1271		2400
	1	Adult	♀	1463	2033	2100-(Sedentary)
Caries-active	20	4-6		1316	1506	1600
	37	7-9		1670		2000
	37	10-12		1546	1732	2500
	18	13-15	♂	1698	2501	3200
	15	13-15	♀	1418	2033	2800
	7	16-20	♂	2082		3800
	41	16-20	♀	1439		2400
	10	Adult	♂	1628	2796	2500-(Sedentary) 3000-(Mod. active)
	23	Adult	♀	1401	2033	2100-(Sedentary)
Erosion	20	Adult	♂	1627	2796	2500-(Sedentary) 3000-(Mod. active)
	51	Adult	♀	1356	2033	2100-(Sedentary)
Students	130	16-20	♀	1542		2400
Unclassified	30	Adult	♀	1477	2033	2100-(Sedentary)

Whatever the extent of the handicaps, patients can be habituated to new routines. Case reports in Tables 12 and 13 indicate the ultimate possibilities. The former summarizes findings and recommendations for a 5-year-old child, demonstrating reversion to the normal of rather wide divergencies in salivary content and a change in tooth status

TABLE 9.—HISTORY RECORD

Name
Date
Sex Age Wt. Ht.
Nationality Religion Race
Medical History: Date
Childhood diseases
Digestive disturbances
Diet habits
Likes
Dislikes
General needs
Breakfast
Lunch
Supper
Laboratory findings
Saliva
Blood
Urine
Nervous condition
General adeptness
Sleep: Hours Sound Restless
Number of members in family
Health of mother
General
Prenatal
Health of father
Health of children
Dental history
Charting
X-ray
Income: Father Mother Children
Expenses: Rent No. of rooms Food

from possible early occlusal decalcification to a caries-free equilibrium. Quarterly clinical checks indicated the cessation of any incipiency within nine months. The second gives similar data for a 15-year-old child suffering from rampant decay. Analyses here are more characteristic of caries, perhaps because it was not coupled with a cold as in the previous case. An interesting observation is the approach toward the normal from both higher and lower levels. After eleven months, proximal decalcification was arrested.

Group response is evidenced in two recent compilations of data. In one study of seventy-three individuals who have different home environments and who followed the recommendations with varying degrees of cooperation, 86 per cent enjoyed systemic and dental benefit and 40 per cent show dental improvement. Figure 3, representing the series divided into caries and erosion subgroups, serves to point out somewhat more frequent body adjustment among the latter in that there is 96 per cent betterment as compared with 82 per

TABLE 10.—DIET RECORD

Name
Address
Age
Weight
Height
Dr.
Record of food (including water) and amount of each taken at every meal and between meals for seven days beginning

cent for the former; the dental improvement running virtually parallel.

The other investigation deals with forty-eight institutionalized children who, after completion of dental work, were started on the routine herein described. Only partial regulation was enforced, but, at the end of the first seven months, 42.8 per cent of those ranging in age from 7 to 12, and 31.8 per cent of the 13 to 17 year group, were caries free. Greater freedom was allowed the older children in choice of food through platter service. Money supplied for lunch at high school was often used to buy cake, candy and ice-cream. Some did not take cod-liver oil. Contrarily, the younger children had their food apportioned

and had no spending money, and all took cod-liver oil. However, the water and fruit-vegetable intake was low. During the next months, irregularities in dietary control arose with attending laxity regarding the cod-liver oil requirement and the portions of all foods served. Within comparatively short periods, a definite spread in susceptibility was noted. The extent of progressive increase is plotted in Figure 4.

It appears, then, that the degree of alleviation depends on the amount of nutritional regulation, a guide for which may be found in "Health Watch Words," Table 14, and the "Score Card for Lay Evaluation of Daily Nutrition Needs," Table 15.

Distribution material should be kept abreast of changing ideas so that the lay person as well as the professional can continue to be informed. Oral interpolations are not always convincing. Tables 14 and 15, previously mentioned, fall into this category, but will be referred to here for the sake of completeness.

TABLE 11.—ANALYSIS

Re: Date:

Recommendations:

A Diet: Make the following habitual

1
2
3
4
5

CLASS A Non-Vegetable, Non-Fruit Portions	CLASS B Vegetable-Fruit Portions
2½ oz. meat or fish	1 fruit in season
1 egg	1 medium potato
2 slices bread	1 medium carrot, turnip or beet
1 in. cube pressed cheese or ½ cup cottage cheese	½ cup green leafy vegetable
½ cup cereal or macaroni or noodles or corn	Similar foods—all fruits and all vegetables except corn and prunes
Similar foods of non-vegetable or non-fruit type	

B Send to Dr. record of weight and diet for week of

C Report to Dr. details of health.

D More than one portion of any food in Class A is allowed, if it is balanced with portions of Class B daily. Note that no radical change of diet has been made. Daily balance is essential.

E Sample menu should be used as a guide always.

F Have at least hours sleep and rest, making certain that there is no feeling of being overtired.

G It is imperative that you understand thoroughly all recommendations. If questions arise, call for explanations.

1. "Health Watch Words," Table 14, presents a general summary of the requirements for nutrition regulation. This has been employed also as an outline for short talks. The details can be few or many and colored to suit the caliber of the audience. It lists ten rules for health and includes the suggested classification of solid foods. This material can be

easily drawn up in booklet form. As such, it would be generally more attractive for lay groups and would be worth trying out.

2. "Care for the Teeth," Table 16 (a booklet on which is being experimented with) emphasizes dental health. It lays stress on the continuity of an early adopted routine, so often discontinued. Avoiding a break in habits established as a result of training at prenatal and baby clinics is a matter that should receive increasing recognition. Actually, having succeeded thus far, it is wiser for us to make the child father of the man. Otherwise, what a backward step—building up health only to break it down. Healthy, energetic childhood must be continued to make the child capable of ripening into buoyant, ambitious adolescence and then maturing to well-developed, productive adulthood.

3. "Score Card for Lay Evaluation of Daily Nutrition Needs," Table 15,

TABLE 12.—CHANGE FROM POSSIBLE INCIPIENT SUSCEPTIBILITY TO CARIES-FREE CONDITION

Case Report: 186 I, 5 years old

Initial	After Twenty-One Months	After Fifteen Additional Months
1. Findings	1. Findings	1. Findings
Saliva	Saliva	
pH* 6.7†	pH 7.02 †	
Calcium 8.2†	Calcium 6.3 †	
Magnesium 1.0†	Magnesium 0.46 †	
Inorganic phosphate 31.3†	Inorganic phosphate 14.0 †	
Protein 629.00†	Protein 297.00 †	
Lipid P	Lipid P 7.4 †	
Cholesterol 16.8†	Cholesterol 0.19 †	
Diet	Diet	Diet
Fruit-vegetable portions, 3	Fruit-vegetable portions, 2.3	Fruit-vegetable portions, 2
Non-fruit, non-vegetable 1	Non-fruit, non-vegetable 1	Non-fruit, non-vegetable 1
Eggs, 4 weekly distributed over 2 days	Eggs, 5½ weekly distributed over 4 days	Eggs, 7 weekly distributed over 7 days
Physiology	Physiology	Physiology
Slight throat redness noted afternoon of test	Healthy	Healthy
Questionable susceptibility to decay—no definite lesion	Caries free	Caries free
2. Recommendations	2. Recommendations:	2. Recommendations:
Decrease slowly fruit, vegetables	Continue with decrease in fruits, vegetables	Continue with decrease in fruits, vegetables

*The normal ranges are: pH: 7.14±0.04; calcium: 6.3±0.4; magnesium: 0.46±0.07; inorganic phosphate: 15.2±1.0; protein: 298±17; lipid phosphorus: 0.13±0.02; cholesterol: 7.5±0.7.

†Milligrams per hundred cubic centimeters.

3. "Score Card for Lay Evaluation of Daily Nutrition Needs," Table 15,

which can be presented as a booklet, allots equal percentage value to the essentials, advisedly made ten to give 100 per cent, thereby minimizing the inclusion of unnecessary foods. Making intelligence a criterion is leaving each individual to accept personal responsibility, low outlay serving as an inducement. The daily cost is respectively 23, 26, 28, 31, 35 and 41 cents for the 1, 5, 10 and 15 year old girl, woman in late pregnancy, 15 year old boy and man. Cal-

TABLE 13.—ALLEVIATION OF EXTREME CARIES SUSCEPTIBILITY

Case Report: 16 C, 15 years old

Initial	After Five Months	After Six Additional Months
1. Findings	1. Findings	1. Findings
Saliva	Saliva	
pH* 7.1 †	pH 7.0 †	
Calcium 5.3 †	Calcium 5.0 †	
Magnesium 0.62†	Magnesium 0.41†	
Inorganic phosphate 13.2 †	Inorganic phosphate 15.5 †	
Protein 300.00†	Protein 306.00†	
Lipid P 0.18†	Lipid P 0.14†	
Cholesterol 10.9 †	Cholesterol 6.5 †	
Diet	Diet	
Calories somewhat low	Low water	
Low water intake	Fruit-vegetable portion, 1.4	
Low milk intake	Non-fruit, non-vegetable, 1	
Fruit-vegetable portion,1		
Non-fruit, non-vegetable, 1.4		
High bread, cereal, cake intake		
No vitamin D source		
Physiology	Physiology	Physiology
Generally healthy	Generally healthy	Decalcification arrested
Caries rampant occlusally and interproximally	Apparently no noticeable change in dental picture	No new cavities
		Enamel texture improved
2. Recommendations:	2. Recommendations:	2. Recommendations:
Keep caloric intake at 1,800	Increase water intake.	Continue with previous advice
Increase milk to 3 glasses	Substitute fruit for cake (dessert)	
Slowly increase water to 8 glasses, including juices	Use Pablum instead of other cereals	
Slowly increase fruits, vegetables, especially raw	Use irradiated milk instead of cod liver oil	
Decrease slowly bread, cereal, cake		
Take 2 tsp. cod liver oil		

*The normal ranges are: pH: 7.14±0.04; calcium: 6.3±0.4; magnesium: 0.46±0.07; inorganic phosphate: 15.2±1.0; lipid phosphorus: 0.13±0.02; protein: 298±17; cholesterol: 7.5±0.7.

†Milligrams per hundred cubic centimeters.

culations were made on the basis of average retail food prices, June 1942.[50]

4. "Weekly Food Order for a Family of Five," Table 17, will answer questions on what to purchase for the family. The itemized list showing an expenditure of $10.91 is based on the needs of a family group with children of 5, 10 and 15 years. The last was represented as a boy so that the greater intake would be allowed for.

5. "Sample Menus," Table 18, which can be used as sheets or folded into booklets, have been drawn up to meet the need for convenient forms. Approximate costs, calories and general rules are included as guides.

6. "Economy Salad Recipes for All Greens," Table 19, answers inquiries regarding where and how to include the greens so frequently discarded. They have been experimented with and the uses suggested have been found to be entirely practical. This is equally true for

TABLE 14.—HEALTH WATCH WORDS, DENTAL AND GENERAL

1. Plan
   Your money will go farther.
   Your energy will be saved.
2. Regular daily use of proper food portions:
   Milk: Evaporated or fresh pasteurized: children: 3 to 4 glasses; adults: 2 glasses.
   Cod liver oil: 1 teaspoonful for everybody.
   Vegetables: 1 potato; 1 portion of green leafy vegetables, frequently raw; 1 portion of carrots, beets or turnips, frequently raw. Learn to eat 2 fruits and 2 vegetables raw. Wash them well, but do not soak them long.
   Fruits: 8 ounces juice (grapefruit, canned tomato, orange) or one whole citrous fruit, one other raw fruit in season.
   Egg: 1 brown or white; for very low income, 4 weekly.
   Meat or fish: 3 ounces, bought sliced thin, steamed 20 minutes.
   Dark bread: 2 slices; dark cereal: 1 cupful.
   Butter: 1 ounce.
   Water: 6 glasses.
   When more food is needed, take 1½ portions fruit-vegetable foods to each portion of non-fruit, non-vegetable food.

Fruit-vegetable portions	Non-fruit, non-vegetable portions
1 apple, orange, pear	2½ ounces meat or fish
1½ peaches or apricots in season	1 egg
1 medium potato	1 inch cube pressed cheese or ½ cup cottage cheese
½ cup greens of beets, carrots, turnips, radishes	2 slices dark bread
Similar foods except prunes and corn	½ cup dark cereal
	Similar foods of non-fruit, non-vegetable type

3. Regular and sufficient rest—enough to take one through daily tasks, including recreation, without feeling tired.
4. Abundant fresh air—work, play, sleep with windows open.
5. Avoid self-prescribed proprietary preparations—medicines, vitamin concentrates.
6. Chase germs with cleanliness.
7. Have regular annual medical check.
8. Have regular dental examination, every six months.
9. Obtain information from authorized sources—physician, dentist, school, health center, dental clinic, American Medical Association, American Dental Association.
10. Health costs less than sickness.

"economy vitamin-mineral-rich meat pie," Table 20, and "economy soup with greens," Table 21.

Finally, the principles set forth are fundamental foci of biochemical considerations concerning the needs of the organism. The recommendations embody practical guides for applying the several hypotheses for caries prevention.

TABLE 15.—SCORE CARD FOR LAY EVALUATION OF DAILY NUTRITION NEEDS

A means of determining adherence to or extent of deviation from the standard recommended.

1. Milk—evaporated or fresh pasteurized. 10%
   Children, 3 to 4 glasses.
   Adults, 2 glasses.
2. Cod liver oil. 10%
   Everybody, 1 teaspoonful.
3. Vegetables—frequently raw. 10%
   1 potato (macaroni, rice, corn or other prepared flour products are not to be substituted for potato).
   1 portion of leafy vegetables or leafy tops.
   1 portion of carrots, beets or turnips.
4. One citrous fruit or 8 ounces of juice. 10%
   Grapefruit
   Canned tomato
   Orange
   One other fruit in season, often raw.
5. One egg (at least 4 weekly). 10%
6. Three ounces of meat or fish. 10%
7. Two slices of dark bread; one portion dark cereal. 10%
8. Two tablespoons of butter. 10%
9. Six glasses of water. 10%
10. Rest: Children, 10 to 12 hours; adults, 8 hours. 10%

Intelligent choice secures all these at low cost: 1 year old, 23 cents; 5 year old, 26 cents; 10 year old, 28 cents; 15 year ♀, 31 cents; 15 year ♂, 35 cents; adult ♀, 31 cents; adult ♂, 41 cents (June 1942).

A GOOD RULE TO FOLLOW IS: Take 1½ portions fruit-vegetable foods (frequently raw) to each portion of non-fruit, non-vegetable ones. Restrict sugar to natural sugars in fruits, certain vegetables, honey, molasses and brown sugar. Candy, ice cream, cake and crackers should be virtually excluded.

1. Mechanical damage due to particle size[51, 52, 53] is avoided by the exclusion of crackers. (Table 18.)

2. Vitamins[54, 55, 56] are allotted in ample amounts for all age levels. They are obtained from natural foods, and so there is little likelihood that any less known associated factors will be deficient, as may occur when synthetic preparations are used. (Tables 6 and 7.)

3. Minerals now stamped essential have been guarded. (Tables 6 and 7.) As was said regarding vitamins, natural sources insure against the lack of other minerals that may be deemed necessary. Apportionment has taken into account resultant metabolic balance between positive and negative ions so that the régimes suggested would leave a protective surplus of basic elements in the tissues.[57]

4. Production or accumulation of acids from carbohydrates, especially easily fermentable types, [58, 59] has been given minimal play. Candy, cake and crackers are generally not allowed as undesirable. They satisfy the appetite, but leave the organism wanting. Their food value is incommensurate with their cost. Meals are completed with raw fruits (or vegetables, although these are not so popular.)

5. At the same time, spontaneous cleansing is effected and jaw exercise afforded.

6. Medication, whether with zephiran,[60] fluorine[61] or any other substance, can at best act only to combat local damage.

But what if susceptible areas have become predisposed to decay because of conditions arising elsewhere in the body? Experiments with radioactive isotopes[62, 63] postulate that teeth may not be permanent inert structures, but may be subject to an active exchange of the materials constituting them. Teeth may come to be regarded as indicators of the systemic status, succumbing to early malfunction in a great majority. The results of failure to heed signals were seen in the medical and dental examination of selectees. Correction and relief can be obtained by aiming at optimal nutritional needs. The handwriting on

TABLE 16.—CARE FOR THE TEETH

Even the baby teeth must be cared for because they are needed for:

1. Healthy jaw development.
2. Safeguarding spaces for permanent teeth; avoiding the likelihood of shifting and irregularity of the teeth.
3. Good chewing and digestion.
4. Strong gums.
5. A healthy body free of harmful germs.

Therefore:

1. Continue to take the child to the physician once a year.
2. Let the dentist examine his mouth when he is 2, earlier would be better, then revisit the dentist every six months.
3. Give him abundant fresh air during sleep as well as play.
4. Continue his regular and abundant rest.

Mother, this is how you can help still more! Father, so can you.

1. See that your child keeps all appointments. If your child cannot keep an appointment please ask for another date.
2. Teach your child to brush his teeth at least after morning and evening meals.
3. Make home pleasant and peaceful.
4. Give him daily the right foods in right portions; avoid the wrong ones.
5. Come to us for more information.

TABLE 17.—WEEKLY FOOD ORDER FOR A FAMILY OF FIVE

Foods	Actual Amounts	Purchase List	Price
Milk			
Approved, bottle	5 quarts, ½ pint	5 quarts	$ 0.60
Evaporated milk (14½ oz.)	24.1 cans	24 cans	2.00
Vegetables			
Fresh carrots, beets, onions, turnips	11.1 lb.	11 lb.	0.61
Fresh cabbage, beet tops, greens	4.2 lb.	4 lb.	0.24
Canned tomatoes (No. 2 can)	16.1 oz.	12 oz. can	0.11
Dried peas and beans	2.7 lb.	3 lb.	0.32
Potatoes	10.5 lb.	10.5 lb.	0.42
Fruit			
Fresh oranges, apples, fruit in season of same price range	26.7 lb.	27 lb.	2.30
Cheese	4.2 oz.	4 oz.	0.06
Eggs, Grade B	20	20	0.62
Meat	1.6 lb.	2 lb.	0.54
Fish	0.9 lb.	1 lb.	0.16
Bread and Cereals			
Bread, whole wheat, 24 hours old	14.6 lb.	15 lb.	0.99
Dark cereals—oatmeal, wheatsworth, etc.	1.9 lb.	2 lb.	0.26
White cereals—macaroni, rice, etc.	1.6 lb.	2 lb.	0.19
Butter and Fats			
Butter	31.5 oz.	2 lb.	0.84
Oil	1.75 oz.	2 oz.	0.03
Cod liver oil	5.00 oz.	5 oz.	0.30
Sugar	0.7 lb.	1 lb.	0.06
Miscellaneous			
Cocoa	6.3 oz.	8 oz.	0.08
Coffee	0.7 oz.	1 oz.	0.02
Molasses	22.1 oz.	1 can (19 oz.)	0.16
			$10.91

10/23/42

the wall is just being recognized. More than ever, health and welfare agencies show a willingness toward concerted efforts in this direction.

The control of dental caries as a practicable attainment seems a reasonable forecast.

TABLE 18.—SAMPLE MENU FOR FIVE-YEAR-OLD CHILD

Time	Food	Portion
On rising:	Water	1 glass
Breakfast:	Cod liver oil	1 tsp.
	Cereal, whole grain with	½ cup
	evaporated milk*	½ cup
	Molasses	2 tsp.
	Fresh milk	1 cup
Mid morning:	Raw carrot	1 medium
	Water	1 glass
Lunch:	Green leafy vegetable	½ cup
	Potato	1 medium
	Butter	1 pat
	Bread, whole grain, 24 hours old	1 slice
	Raw fruit in season	1 medium
	Water	1 glass
Afternoon:	Fresh milk	1 cup
	Bread, whole grain, 24 hours old	1 slice
	Butter	1 pat
	Water	1 glass
Dinner:	Split pea soup made with split peas	¼ cup
	Evaporated milk*	¼ cup
	Egg, 4 times weekly, substituted by	1
	Meat, once weekly	2½ oz.
	Fish, once weekly	2½ oz.
	Bread, once weekly	2 slices
	Turnip	½ cup
	Bread, whole grain, 24 hours old	2 slices
	Butter	1 pat
	Fruit, preferably raw	1
	Water	1 glass

Approximate total calories, 1,500 Approximate cost, 26 cents

1. Meals or parts of meals may be interchanged.
2. General rule: 1½ to 2 portions of the fruit-vegetable foods to 1 portion of non-fruit, non-vegetable foods.
3. Candy, ice cream, cake and crackers should be excluded.

*Diluted equally with water.

BIBLIOGRAPHY

1. HAMMETT, F. S.: Biochemical Study of Bone Growth; Changes in Calcium, Magnesium and Phosphorus of Bone During Growth. *J. Biol. Chem.*, 64:685, July 1925.
2. HOWLAND, J.; MARRIOT, W. M., and KRAMER, B.: Inorganic Composition of Bones. *J. Biol. Chem.*, 68:721, June 1926.
3. KRAMER, B., and SHEAR, M. J.: Composition of Bone; Primary Calcification. *J. Biol. Chem.*, 79:147, September 1928.
4. HOWLAND, J., and KRAMER, B.: Calcium and Inorganic Phosphorus of Serum in Relation to Rickets and Tetany. *Monatschr. f. Kinderh.*, 25:279, March 1923.
5. HESS, A. F.: Rickets Including Osteomalacia and Tetany. Philadelphia: Lea & Febiger, 1929.
6. MELLANBY, EDWARD: Experimental Rickets: Effect of Cereals and Their Interaction with Other Factors of Diet and Environment in Producing Rickets. British Medical Research Council. Special Reprint Series No. 93, 1925.
7. SHIPLEY, P. G.; KRAMER, B., and HOWLAND, J.: Calcification of Rachitic Bones in Vitro. *Am. J. Dis. Child.*, 30:37, July 1925.
8. STEARNS, G., and BOYD, J. D.: Healing of Rickets Coincident with Low Serum Inorganic Phosphorus. *J. Clin. Investigation*, 10:591, August 1931.
9. KRAMER, B., and TISDALL, F. F.: Simple Technique for Determination of Calcium and Magnesium in Small Amounts of Serum. *J. Biol. Chem.*, 47:475, August 1921.

TISDALL, F. F.: Kramer-Tisdall Method for Determination of Calcium in Small Amounts of Serum. *J. Biol. Chem.*, 56:439, June 1923.

10. TISDALL, F. F.: Rapid Colorimetric Method for Quantitative Determination of

Inorganic Phosphorus in Small Amounts of Serum. *J. Biol. Chem.*, 50:329, February 1922.

11. VAN SLYKE, D. D., and CULLEN, G. E.: Studies of Acidosis. I. Bicarbonate Concentration of Blood Plasma: Significance and Determination as Measure of Acidosis. *J. Biol. Chem.*, 30:289, 1917.

VAN SLYKE, D. D.: Studies of Acidosis. II. Method for Determination of Carbon Dioxide and Carbonates in Solution. *J. Biol. Chem.*, 30:347, 1917.

CULLEN, G. E.: Studies of Acidosis. III. Electrometric Titration of Plasma as Measure of Alkaline Reserve. *J. Biol. Chem.*, 30:369, 1917.

12. VAN SLYKE, D. D., and NEILL, J. M.: Determination of Gases in Blood and Other Solutions by Vacuum Extraction and Manometric Measurement. *J. Biol. Chem.*, 61:523, September 1924.

13. FOLIN, O., and WU, H.: System of Blood Analysis. *J. Biol. Chem.*, 38:81, May 1919.

System of Blood Analysis; Simplified and Improved Method for Determination of Sugar. *J. Biol. Chem.*, 41:367, March 1920.

System of Blood Analysis; New Colorimetric Method for Determination of Amino-Acid Nitrogen in Blood. *J. Biol. Chem.*, 51:377, April 1922.

FOLIN, O.: System of Blood Analysis; Revision of Method for Determining Uric Acid. *J. Biol. Chem.*, 54:153, October 1922.

14. MYERS, V. C., and WARDELL, W. L.: Colorimetric Estimation of Cholesterol in Blood, with Note on Estimation of Coprosterol in Feces. *J. Biol. Chem.*, 36:147, October 1918.

15. KRASNOW, FRANCES, and ROSEN, A. S.: Method for Determination of Lipin Phosphorus. *Soc. Exper. Biol. & Med.*, 26:67, October 1928.

16. MACLEOD, J. J. R.: Physiology and Biochemistry in Modern Medicine. Ed. 2. St. Louis: C. V. Mosby Company, 1919, p. 696.

17. MATHEWS, A. P.: Physiological Chemistry. Ed. 4. New York: William Wood and Company, 1925, p. 1068.

18. STARR, H. E.: Studies of Human Mixed Saliva. I. Determination of Hydrogen Ion Concentration of Human Mixed Saliva. *J. Biol. Chem.*, 54:43-55, September 1922.

19. BUNZELL, H. H.: True Acidity or Alkalinity (Hydrogen Ion Concentration) of Mixed Normal Saliva as Obtained from Resting Mouth. Bull. No. 1, 1923, Colgate and Company.

20. HENDERSON, M., and MILLET, J. A. P.: Hydrogen Ion Concentration of Normal Saliva. *J. Biol. Chem.*, 75:559, November 1927.

21. HORTON, K.; MORRACK, J., and PRICE, I.: Relation of Calcium in Saliva to Dental Caries. *Biochem. J.*, 23:1075, 1929.

22. CLARK, G. W., and SHELL, J. S.: Influence of Diet upon Inorganic Constituents of

TABLE 19.—ECONOMY SALAD RECIPES FOR ALL GREENS

Green salad: Any mixture of the following with or without dressing as taste requires. If dressing is used, it should be of the very dilute type; e.g., in the case of mayonnaise, take 1 portion to 4 of water and stir to uniform consistency.

Grated or shredded cabbage
Celery leaves cut fine
Radish leaves cut fine
Beet leaves cut fine
Carrot leaves cut fine, not stems
Any other greens

Salmon or tuna fish salad: Any of the greens used in the green salad may be cut particularly fine and mixed with the salmon or tuna fish in the proportion of half fish to half greens. For this mixture, additional flavor (especially when habit is being formed) is obtained by dicing in some celery. All juice should be used.

Egg salad: Any of the greens used in the green salad may be cut particularly fine and mixed with the egg in proportion of half egg to half greens. For this mixture, additional palatability is obtained by dicing in some celery. Any oil or solid fat may be used for the shortening, if so desired.

For devilled eggs, finely chopped greens may be mixed in as filling.

Sardine-egg salad: It is a very tasty change to mash sardines and eggs with the greens as prepared for the salmon. All the oil from the sardines should be included.

Chicken salad: Prepared with the greens as in the other salads.

Human Saliva. *D. Cosmos,* 69:500, May; 605, June 1927.

23. KRASNOW, FRANCES: Biochemical Analysis of Saliva in Relation to Caries. *D. Cosmos,* 78:301, March 1936.

24. MELLANBY, MAY: Influence of Diet on Structure of Teeth. *Physiol. Rev.,* 8:545, October 1928.

25. BOYD, J. D.; DRAIN, C. L., and NELSON, M. V.: Dietary Control of Dental Caries. *Am. J. Dis. Child.,* 38:721, October 1929.

26. HAWKINS, H. F.: Dental Decay—What It Is and Means for Its Control. J.A.D.A., 16:781, May 1929.

TABLE 20.—ECONOMY VITAMIN-MINERAL-RICH MEAT PIE

Recipe
Materials needed:
3 pounds potatoes (cooked, mashed or raw with skins put through the meat chopper)
¾ lb. meat, chopped or cubed
½ lb. string beans, carrots or turnips
1½ cup finely cut or chopped greens from celery, carrots, beets or any others
¼ lb. cooked lentils
1 onion (if desired)
Condiments, salt and pepper to taste
Layer in hot greased pan as follows:
First: layer of ½ mashed potatoes or grated raw potatoes including skins
Second: ¼ lb. string beans cut as desired or diced carrots or turnips
Third: ¾ lb. cubed meat mixed with ¾ cup celery leaves cut fine ¾ cup carrot leaves or beet leaves ¼ lb. cooked lentils 1 onion (if desired)
Fourth: Repeat second layer
Fifth: Repeat first layer
Bake in ovenette 1 hour on ¾ heat.
Divide into 4 large or 5 medium portions.

27. MELLANBY, MAY, and PATTISON, C. L.: Remarks on Influence of Cereal-Free Diet Rich in Vitamin D and Calcium on Dental Caries in Children. *Brit. M. J.,* 1:507, March 19, 1932.

28. KRASNOW, FRANCES; OBLATT, EDITH B., and KAPLAN, N.: Collection of Human Saliva for Quantitative Biochemical Studies. *J. D. Res.,* 15:367, September 1936.

29. KARSHAN, MAXWELL; KRASNOW, FRANCES, and KREJCI, L. E.: Study of Blood and Saliva in Relation to Immunity and Susceptibility to Dental Caries. *J. D. Res.,* 11:573, August 1931.

30. KRASNOW, FRANCES; KARSHAN, MAXWELL, and KREJCI, L. E.: Determination of Calcium and Phosphorus in Saliva. *J. Lab. & Clin. Med.,* 17:1148, August 1932.

31. Unpublished communication.

32. KRASNOW, FRANCES, and OBLATT, EDITH B.: Studies of Variation in Salivary Protein. *J. D. Res.,* 13:239, June 1933.

33. KRASNOW, FRANCES; ROSEN, A. S., and POROSOWSKA, Y.: Determination of Lipid Phosphorus; Alcohol Ether Soluble Phosphorus. *J. Lab. & Clin. Med.,* 20:1090, July 1935.

34. KRASNOW, FRANCES, and OBLATT, EDITH B.: Salivary Cholesterol. *J. D. Res.,* 16:151, April 1937.

35. PEARL, R.: Introduction to Medical Biochemistry and Statistics. Ed. 2. Philadelphia: W. B. Saunders Company, 1930.

36. HAWK, P. B., and BERGEIM, O.: Practical Physiological Chemistry. Ed. 11. Philadelphia: P. Blakiston's Son & Co., 1937, p. 407.

37. MCLESTER, J. S.: Diagnostic Value of Blood Fibrin Determinations, with Special Reference to Disease of Liver. *J.A.M.A.,* 79: 17, July 1, 1922.

38. VARS, H. M.: Concentration of Fibrin Yielded by Canine Plasma in Relation to Dietary Factors. *Am. J. Physiol.,* 93:554, June 1930.

39. BODANSKY, M.: Introduction to Physiological Chemistry. Ed. 4. New York: John Wiley & Sons, 1938, p. 241.

40. PATTERSON, J. W. T.: Blood-Fat and Exercise. *Biochem. J.,* 21:958, 1927.

41. STEWART, C. P.; GADDIE, R., and DUNLOP, D. M.: Fat Metabolism in Muscular Exercise. *Biochem. J.,* 25:733, 1931.

42. BOYD, E. M.: Lipemia of Pregnancy. *J. Clin. Investigation,* 13:347, March 1934.

43. ROSE, MARY S.: Foundations of Nutrition. Ed. 3. New York: Macmillan Company, 1938.

44. BOWES, ANNA D., and CHURCH, C. F.:

TABLE 21.—ECONOMY SOUP WITH GREENS

Any or a combination of greens:
- Grated or shredded cabbage
- Celery leaves cut fine
- Radish leaves cut fine
- Carrot leaves cut fine, not stems
- Others as obtained (except rhubarb leaves)

These can be put through a meat chopper or other masher. The entire pulp may then be used to make purees or thin soups as taste requires. This pulp can be variously combined with lentils, peas, potatoes, carrots or any combination of them. Lentils give a flavor simulating that of meat, which is very desirable.

Food Values of Portions Commonly Served. Philadelphia, 1937.

45. SHERMAN, H. C.: Chemistry of Food and Nutrition. Ed. 4, 1932; Ed. 6, 1941. New York: Macmillan Company.

46. MUNZELL, H. E.: Vitamins and Their Occurrence in Foods. *Milbank Memorial Fund Quart.*, 18, No. 4, October 1940.

47. PROUDFIT, F. T.: Nutrition and Diet Therapy. Ed. 5, 1931; Ed. 7, 1938. New York: Macmillan Company.

48. MACY, ICY G.: Nutrition and Chemical Growth in Childhood. Vol. 1. Springfield, Ill.: Charles C. Thomas Co., 1942.

49. Report of Section on Public Health and Medical Aspects of Nutrition, National Nutrition Conference for Defense. *Pub. Health Rep.*, 56:1243, June 13, 1941.

50. Average Retail Fruit Prices in New York City. Social Welfare and Public Health Department, New York City Home Economics Association, June 1942.

51. SHIBATA, M.: *Jap. J. Exper. Med.*, 7: 247, April 10, 1929.

52. HOPPERT, C. A.; WEBBER, P. A., and CANNIFF, T. L.: Production of Dental Caries in Rats Fed an Adequate Diet. *Science*, 74:77, January 1931.

53. ROSEBURY, THEODOR; KARSHAN, K., and FOLEY, GENEVIEVE: Studies, in the Rat, of Susceptibility to Dental Caries. *J. D. Res.*, 13:379, October 1933.

54. MELLANBY, MAY: Medical Research Council. Special Report 159, London, 1931.

55. HANKE, M. T.: Diet and Dental Health. University of Chicago Press, 1933, p. 140.

56. MCBEATH, E. C.: Experiments on Dietary Control of Dental Caries in Children. *J. D. Res.*, 12:723, October 1932.

57. JONES, MARTHA R.: Changing Concept of Adequate Diet in Relation to Dental Disease. *D. Cosmos*, 77:535, June; 651, July; 747, August 1935.

58. BUNTING, R. W.: Diet and Dental Caries. J.A.D.A., 22:144, January 1935.

59. JAY, PHILIP: Rôle of Sugar in the Etiology of Dental Caries. J.A.D.A., 27:393, March 1940.

60. BAKER, ZELMA; HARRISON, R. W., and MILLER, B. F.: Bactericidal Action of Synthetic Detergents. *J. Exper. Med.*, 74:611, February 1941.

61. BIBBY, B. G.: New Approach to Caries Prophylaxis. Preliminary Report on Use of Fluoride Applications. *Tufts D. Outlook*, 15:4, May 1942.

62. AUB, J. C., and CALHOUN, K. A.: Radium Is Deposited Along with Calcium in Dentin According to Shobl, A. T., in Mineral Metabolism. New York: Reinhold Publishing Corporation, 1939, p. 145.

63. VOLKER, J. F., *et al.*: Adsorption of Fluoride by Enamel, Dentin, Bone and Hydioxylapatite as Shown by Radioactive Isotope. *J. Biol. Chem.*, 132:543, July 1940.

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EXTRA-ORAL UTILIZATION OF SCREWS OR PINS IN THE IMMOBILIZATION OF MANDIBULAR FRACTURES

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NUMEROUS methods have been utilized in the treatment of jaw fractures within the past half century. Thomas L. Gilmer was among the first in the United States to immobilize jaw fractures by wiring teeth together in occlusion. Perhaps the end-results of intermaxillary wiring in the treatment of jaw fractures, when a sufficient number of teeth are present, are as good as from any and better than from some methods. However, the procedure is very disagreeable and uncomfortable for the patient, the undesirable effects being well known to dentists and those who have experienced it.

If, then, satisfactory end-results can be obtained in treating fractures of the mandible by methods allowing normal movements and use of the mandible, including mastication of food, during the immobilization period of fractures of this bone, such a procedure seems to be worth while. Certain extra-oral procedures for immobilizing fractures of the mandible permit normal movements of this bone, allow the patient to masticate food when enough teeth are present, eliminate certain disagreeable and unhygienic conditions of the oral cavity and hold the fractured parts in the desired position until healing ensues.

An article by me published in 1942, including five case reports, outlined and discussed a method of treating fractures of the edentulous mandible, by the utilization of vitallium screws, which is indicated and is effective.

This article pertains to the reduction and immobilization of fractures of the mandible either in the edentulous mandible or in the presence of teeth, by an extra-oral procedure.

REPORT OF CASES

Case 1.—*History.*—D. N., a well-developed well-nourished white man, aged 49, a salesman, admitted to Hines Hospital December 15, 1942, for treatment of an injury to the mandible suffered three days before admission, when he was held up and slugged in the jaw region, complained of severe pain in the jaw region and stated that he could not move his lower jaw normally. There were no other complaints.

Examination.—There was moderate swelling of the right submaxillary region and clinical evidence of fracture, compound, bilateral, of the mandible, with considerable displacement and overriding of the fractured parts. All the upper teeth and six lower teeth were missing. Roentgenograms of the mandible corroborated fracture, bilateral, in areas of the second molar on both sides. The second and third lower molar teeth were missing on the left side, and the lower right second molar was extremely loose and painful, it being in the line of fracture. The four lower anterior teeth were also missing. Remaining lower teeth were very loose, from pyorrhea. Routine examinations, including laboratory reports commonly made in hospitals, were essentially negative other than those of the mandible.

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Operation.—December 18, under local anesthesia and with surgical cleanliness, the fractures were reduced and the parts immobilized by the following procedure: Mandibular, bilateral block anesthesia was administered. The skin of the entire region was thoroughly cleansed by rubbing with alcohol and then painting with a mercurial preparation. The area was next draped and procaine was injected into the skin and muscles in the area where the screws were to be inserted. A stab wound 0.5 cm. long was made through the skin and muscle, extending to the bone. This incision was started near the lower border of the mandible and about 1.5 cm. distally from the right fracture. A drill approximately 2 mm. in diameter was then placed in this incision and a hole 1 cm. in depth was drilled in the buccal area of the mandible, starting near the lower third of

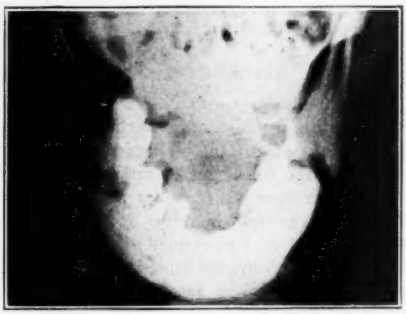

Fig. 1 (Case 1).—Fracture, bilateral compound, of mandible, before treatment. (December 11, 1942.)

the mandible and extending inward and slightly upward at about a 45° angle.

Immediately after the drill was withdrawn, a vitallium screw was placed in the hole and screwed into the bone for the desired depth. A gauze dressing saturated with alcohol was immediately placed around the screw, covering the wound. Next another screw was, by the same procedure, placed in the bone about 1.5 cm. anteriorly from the right fracture. Two more screws, one on each side of the fracture, were then placed in the bone on the left side of the mandible, with the same procedure, approximately the same distance from the fracture and for the same depth as was the first screw mentioned. A stiff wire, which was to be used as an immobilization bar, was then cut the desired length, bent to the approximate position and placed through the holes of four sleeves, which were to be placed over the exposed ends of the screws. The displaced fractured parts were then placed in normal apposition by manual manipulation. The alcohol gauze dressings were removed from the exposed ends of the screws. The sleeves, with the prepared fixation wire in position, were then placed over the ends of the screws, the ends of the fixation bar were bent and the fixation wire was securely wired to the screws, thereby immobilizing the fractured bones. Sterile vaselin was placed over the skin around the screws and dry dressings were placed over

Fig. 2 (Case 1).—Film taken January 5, 1943, revealing screws in position in right mandible, one screw on each side of line of fracture. The screws were inserted to approximately 1 cm. in depth.

the area around the screws. The loose, painful second molar in the line of the right fracture was then removed. The type of screws, sleeves and fixation wire used here were described in the article previously mentioned.

After-Care.—Codeine, one-half grain, was administered to the patient on three occasions within the next forty-eight hours, and aminopyrine in 5-grain doses was administered thereafter infrequently during the next week. The patient was placed on a soft diet

during the treatment period because the upper arch was edentulous. The dressings were removed every forty-eight hours, the screws and surrounding tissue were cleansed with alcohol and the area was redressed; this procedure continuing for three weeks. If the patient had had upper teeth, he could have masticated food during the immobilization period. Drainage developed intra-orally in the region of the right fracture a week after treatment was instituted, and, a week later, a loose sequestrum of bone was removed from the area. Drainage ceased shortly thereafter. Under local anesthesia, the appliance was removed four weeks after insertion.

Outcome.—There was union in both fractures and the skin wounds healed rapidly on removal of the screws. Such wounds completely heal within a few weeks after removal of an appliance. The patient was discharged five weeks from the day of admission.

Fig. 3 (Case 1).—Film taken January 5, 1943, showing two screws in position, one on each side of fracture line, of right mandible. The screws utilized in Case 1 were 3.5 mm. in diameter and 4 cm. in length.

Comment.—Three roentgenograms and one photograph of Case 1 are shown. Figure 1, dated December 14, 1942, shows the fractures before treatment. Figure 2, dated January 5, 1943, shows the right side, with screws, etc., in position. Figure 3, also dated January 5, 1943, shows the left side, with screws and appliance in position. Figure 4, a photograph, shows the fixation appliance in position.

CASE 2.—*History.*—A man, aged 49, admitted to Hines Hospital October 25, 1942, with diagnoses of bronchitis, chronic, severe; pleurisy, fibrous, moderate, bilateral; coronary arteriosclerosis; myocardial damage; myocardial insufficiency; arterial hypertension, and fractures, compound, bilateral of the mandible, stated that he had been slugged on the jaw the day before admission and that he had suffered severe pain in the jaw region since injury.

Examination.—The jaws, upper and lower, were edentulous, and there was extensive swelling of the submaxillary region bilaterally. The chin region was displaced downward and backward. Clinical evidence of compound fracture of the mandible in the second molar region on the right side and distally from the third molar region on the left side was corroborated by roentgenograms.

Operation.—Under local anesthesia, these fractures were reduced and immobilized October 25, 1942, the intra-oral method being utilized whereby vitallium screws were inserted in the alveolar ridge of the mandible on both sides of the fractures, the parts being immobilized by a fixation bar attached to the screws. The fracture of the left side healed within four weeks; but, because of osteomyelitis and an uncontrollable situation, the fracture of the right side did not heal. The disabilities other than of the jaw region were treated by the medical service. The appliance was removed under local anesthesia four weeks after insertion. The infectious process of the jaw region on the right side was treated until the condition improved to the extent that treatment of the fracture could be continued.

Fig. 4 (Case 1).—Fixation bar in position. (January 3, 1943.) This appliance was in position four weeks, union of the fractured parts taking place in the meantime.

Second Operation.—Under sodium pentothal anesthesia, the unhealed fracture of the right side was again reduced and immobilized January 7 by an extra-oral procedure whereby one vitallium screw was placed in the buccal area of the mandible about 1.5 cm. distally from the fracture and two screws were placed in the bone anteriorly from the fracture. The fractured parts were then placed in the desired position and immobilized, the entire procedure, other than anesthesia, being carried out as in Case 1.

After-Care.—The after-care of this patient was also carried out as in Case 1. Infection of the bone and soft tissue developed around the screw that was farthest distally and there was intermittent drainage extra-orally from the area during the last two

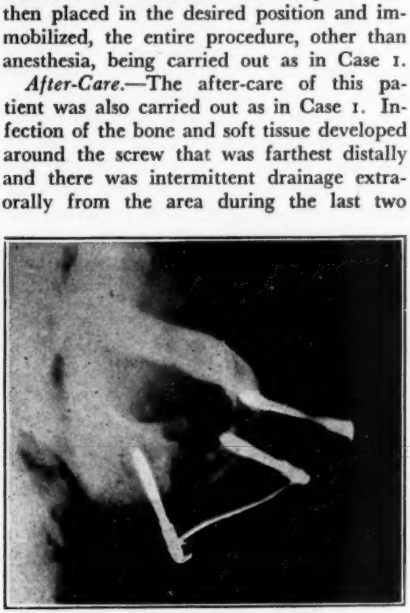

Fig. 5 (Case 2).—Film taken January 9, 1943, showing three screws in position in mandible. One screw was distally from and two screws were mesially from the line of fracture. These screws were the same size as those used in Case 1.

weeks of treatment. The infected area around the distal screw was irrigated during the last two weeks of treatment by placing the tip end of an irrigating syringe in the wound and flushing it with a sulfathiazole solution daily until the appliance was removed. As the patient was edentulous, he was placed on a soft diet during the treatment period. However, he had free movement of the mandible during this procedure.

Comment.—One roentgenogram and two photographs of Case 2 are shown. Figure 5, dated January 9, 1943, a roentgenogram, shows the screws in position. Figure 6, dated January 11, 1943, a photograph, shows the appliance in position, two days after operation. (The fracture is between the two posterior screws.) Figure 7 is a side view of the same case. The fracture was healed by January 28, 1943, and the appliance was removed on that date.

CASE 3.—*History.*—E. S., a white man, well developed and well nourished, a pipe fitter, was admitted to Hines Hospital February 2, 1943 for treatment of an injury to the mandible, being transferred from Indianapolis, Ind., where he had been hospitalized from January 18 to February 2, 1943, because of the jaw injury. The patient stated that he had been slugged in the lower jaw region January 12, 1943, at which time he received an injury to his lower jaw that caused him considerable discomfort and pain. The accident occurred in New Albany, Ind.

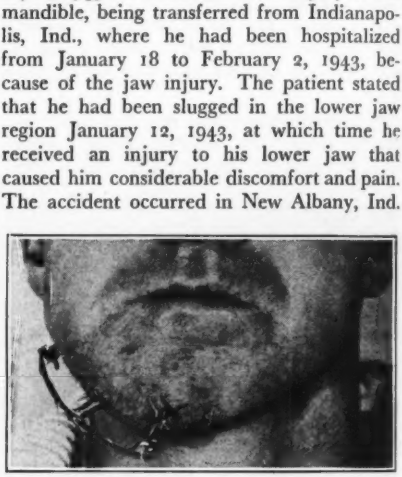

Fig. 6 (Case 2).—Film taken January 11, 1943, two days after operation, illustrating fixation bar attached to exposed ends of screws. This appliance was in position three weeks, union of fracture taking place during this period.

The patient also stated that he had not been able to masticate food or to close his teeth since the injury. There were no complaints other than of the jaw region.

Examination.—Examination revealed normal conditions other than the fracture of the mandibular region. The remaining teeth were extensively abraded. The upper left first and third molars, lower left first molar and lower right first and second molars were missing. The lower right third molar was very loose and painful and there was drainage around this tooth. The upper right central incisor was also very loose and painful. There was moderate swelling of the right submaxillary region and clinical evi-

dence of fracture, compound, bilateral of the mandible, in the region of the first molar on the left side and near the third molar region on the right side. The teeth were considerably out of occlusion owing to the compound fractures. The anterior fragment of the right side was pulled downward.

Operation.—Under local anesthesia, February 3, 1943, these fractures were reduced and immobilized by placing four vitallium screws extra-orally in the buccal area of the mandible, one screw being inserted on each side of the fractures, and each screw placed at a depth of about 1 cm. and about the same distance from the fractures. The badly displaced fractured parts were next placed in the desired position by manual manipulation, and occlusion of the teeth was obtained. Then the fixation bar was attached to the screws, thereby immobilizing the parts. The procedure similar to that of the other two

Fig. 7 (Case 2).—Side view of patient. (Compare Figure 6.)

cases was followed in placing the screws in position. Instead of being round at the head end like the screws utilized in Cases 1 and 2, the screws in this case contained a square slot on the head end, into which a square fixation bar was fitted. The head end of the screw was threaded externally and the fixation bar fastened down securely by means of a knurled nut, shown in Figure 10. This type of appliance allows firmer fixation than the appliance used in Cases 1 and 2.

After-Care.—The area was dressed as in the other cases, the dressing being changed every forty-eight hours for four weeks. The patient was placed on a soft diet for the first two days after operation and thereafter was on a regular diet. He was able to masticate his food during the treatment period. This was quite a relief since he had not been able to chew anything from the date of injury, January 12, until fixation of the fracture, February 3. The loose and painful upper right central incisor was extracted when the fractures were reduced and the lower right third molar was extracted February 10.

Infection developed in the area of the right fracture and there was both intra-oral and extra-oral drainage, the extra-oral drainage from the region of the anterior screw on the right side. Because of continued drainage from this region anteriorly from the right fracture, this screw was removed February 22, and a pin made of Kirchner wire was placed in the bone, on the same date, to help stabilize the fixation appliance. This pin was driven into the bone a distance of about 1 cm. by the aid of an impactor, with

Fig. 8 (Case 3).—Film taken February 5, 1943, revealing screws in position in right mandible, one screw on each side of line of fracture. All screws used in this series were made of vitallium.

no previous incision of the skin or drilling into the bone. The pin was attached firmly to the fixation bar, a clamp being attached to the exposed end of the pin and then wired securely to the fixation bar. Drainage ceased a week after removal of the screw. The infection, in all probability, started in the fracture area and spread to the area of the screw. The pin was placed in healthy tissue a distance of about 2 cm. from the point from which the screw was removed.

Codeine, in one-half grain doses, was administered to the patient at infrequent inter-

vals for the first week, after the fractures were reduced and the parts immobilized.

Outcome.—The patient was fairly comfortable during the course of treatment. The fractures healed, the parts were in good position and occlusion of the teeth was satisfactory, the appliance being removed under local anesthesia March 12. The patient had been able to use the mandible normally during the treatment period. It was necessary to extract the lower right bicuspids and cuspid March 17, because they were so badly abraded that the pulps were becoming involved. The patient was discharged with maximum benefits March 19.

Comment.—Two roentgenograms and one photograph of Case 3 are shown. Figure 8, dated February 5, 1943, roentgenogram of

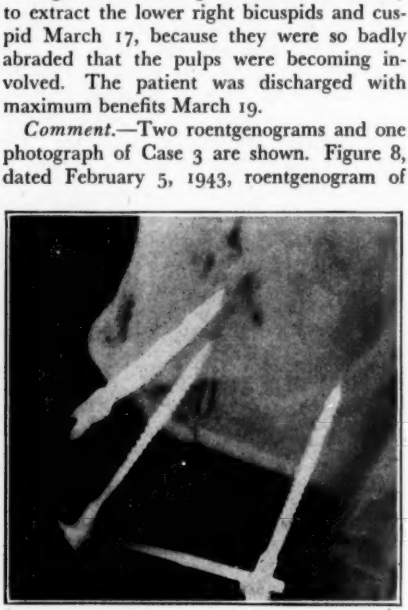

Fig. 9 (Case 3).—Film taken February 5, 1943, showing two screws in left mandible, one screw on each side of fracture.

the right side, reveals the line of fracture and the screws in position after reduction and fixation. Figure 9, also dated February 5, 1943, reveals the screws in position on the left side. Because of angulation, the length of these screws is exaggerated in the roentgenograms. They are 5 cm. long and about 3.5 mm. in diameter. Figure 10, dated February 25, 1943, a photograph, shows the appliance in position.

CASE 4.—*History.*—C. J., aged 48, a well-developed, well-nourished colored man, admitted to Hines Hospital, February 25, 1943, for treatment of an injury to the lower jaw which he received the day before admission when he was slugged on the head and jaw, had no complaints other than pain and discomfort of the jaw.

Examination.—No disabilities were found except of the mandible. Nine upper and twelve lower teeth were present. The lower first and second molars of the right side were missing, the third molar on this side being very loose and painful. There was moderate swelling of the right submaxillary region with clinical evidence of a compound fracture of the right mandible in the area of the second molar with malocclusion, the anterior part of the fractured bone being displaced downward. A roentgenogram of the mandible also revealed a fracture of the right side.

Operation.—Under local anesthesia, the fracture was reduced and the parts were immobilized March 1, the following procedure being employed: Four pins made from

Fig. 10 (Case 3).—Film taken February 25, 1943, showing three screws and one pin inserted in mandible and fixation bar attached to fixation posts.

Kirchner wire were placed in the buccal area of the mandible in pairs of two on each side of the fracture. These pins were 5 cm. in length and 1.5 mm. in diameter, and were filed to a sharp, triangular point on the end to be inserted in the bone. No previous stab wound of the skin was made or hole drilled into the bone before insertion of the pins. Each pin was pushed through soft tissue at the desired location until bone was touched. Then the pin was driven into the bone a depth of about 1 cm. with the aid of an impactor. A hand pressure screw bit may also be used to insert such pins in the bone. A pin was first placed about 1.5 cm. distally from the line of fracture and another pin

was placed in the bone about 1 cm. distally from this first pin.

Next, a pin was placed in position a distance of about 1.5 cm. anteriorly from the line of fracture and the fourth pin was thereafter inserted a distance of 1 cm. anteriorly from the latter pin, each pin being inserted to a depth of about 1 cm. The exposed ends of the two pins distally from the fracture were than fastened together by attaching a cross attachment plate to them, the two anterior pins next being attached by a similar procedure. The fracture was then placed in normal position and immobilized by a fixation bar firmly attached to each attachment plate. The loose lower right third molar was extracted. (I had this appliance constructed in the orthopedic shop connected with Hines Hospital.)

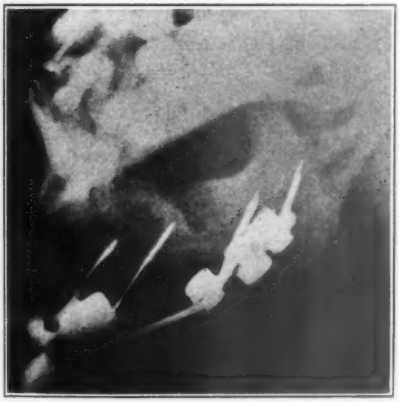

Fig. 11 (Case 4).—Film taken March 3, 1943, showing four pins in position in mandible, two pins on each side of line of fracture. These pins, made of a hard stainless steel, were 1.5 mm. in diameter and 5 cm. in length. They were driven into the bone a distance of about 1 cm. The pins were pushed through the soft tissue at the desired position and then forced into the bone.

After-Care.—The skin around the pins was covered with a sterile dry dressing, which was removed daily, the appliance and skin in the field being cleansed and another dressing placed in position during the next three weeks. Codeine, one-half grain, was administered on two occasions during the next twenty-four hours and aminopyrine in 5-grain doses was administered infrequently during the next two weeks.

Outcome.—The patient was able to masticate food immediately after the fractured parts were immobilized and continued to do so during the three weeks that the appliance was in position. Normal occlusion of the teeth was maintained. The patient was reasonably comfortable during the course of treatment. The appliance was removed under local anesthesia March 22, at which time the fracture was healed; and the patient was dismissed a few days later.

Comment.—One roentgenogram and two photographs of Case 4 are shown. Figure 11, a roentgenogram of the right mandible dated March 2, 1943, shows the fracture and pins in position. Figure 12, dated March 4, 1943, a photograph, shows the appliance in position. Figure 13 shows a side view of the case taken on the same date as Figure 12.

Fig. 12 (Case 4).—Fixation bar attached to each pair of pins, thus immobilizing fractured parts. Each pair of pins were held together by attaching a fixation block to the pins. (March 3, 1943.)

These photographs were taken three days after reduction and immobilization of the fracture.

CASE 5.—*History.*—C. B., a man, aged 48, well-developed ,and well-nourished, a railroader by occupation, admitted to Hines Hospital March 25, 1943 for treatment of an injury received two days before, at which time he was slugged on the jaw region and robbed, stated that extensive pain and discomfort of the jaw region had been present since injury and that he had not been able to chew his food or close his teeth. There were no other complaints.

Examination.—The patient was sent to the Oral Surgery Section, March 27. A lacerated wound was noted on the left side of the face, with moderate swelling involving the submaxillary region. Intra-oral examination revealed that two upper and three lower teeth were missing and the right side of the lower jaw was pulled downward by the suprahyoid muscles, therefore the patient's teeth would not occlude. There was clinical evidence of fracture, compound, bilateral of the mandible, fracture of the left side being in the area of the second molar tooth and near the mental foramen of the right side. Fracture was corroborated by roengenographic examination.

Operation.—Under local anesthesia, the fractured parts were placed in normal position and immobilized, March 29, the appliance being similar to the one utilized in Case 3 and the operative procedure carried out similarly to that in the same case. The loose lower right second bicuspid tooth was removed at the time of operation.

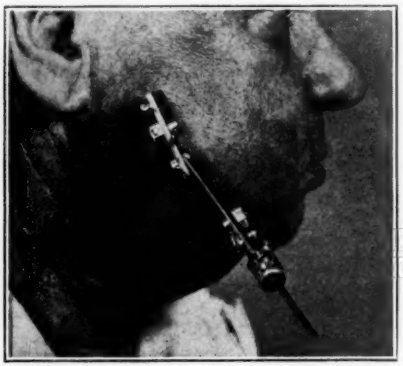

Fig. 13 (Case 4).—Side view of appliance in position. (March 3, 1943.) This appliance was removed three weeks after insertion, the fractured parts having healed. The patient was able to masticate food while the appliance was in position.

After-Care.—After the skin in the region of the screws had been dried and cleansed, 5 grains of pulverized sulfathiazole sodium was sprinkled on the skin where each screw had entered. A gauze dressing saturated in alcohol was then placed around each screw, covering the skin, and a dry dressing was placed over each wet dressing. The same procedure was followed every second day during the treatment period. Morphine, one-sixth grain, was administered two hours after operation and one-half grain of codeine was administered each eight hours for the next two days. The patient was placed on a soft diet for the first week after operation and thereafter was on a regular diet, during the immobilization period. The upper and lower left second molar teeth, which were loose and painful, were removed April 6.

Outcome.—No complications developed during the treatment period. The fractured parts healed and occlusion of the teeth was maintained. The patient was able to move the mandible normally and could masticate food while the immobilization appliance was held in position. Under local anesthesia, the appliance was removed five weeks after being placed in position.

Fig. 14 (Case 5).—Pins in position in mandible. (March 30, 1943.) Two pins were inserted in a crossed position on each side of the fracture line. Because of angulation, the pins on the right of the line of fracture appear to penetrate the fracture line. Actually, these pins are a distance of about 1 cm. from the fracture line.

Comment.—Figure 14, under date of March 30, 1943, shows the fracture of the right mandible reduced and the parts immobilized with screws in position, one on each side of the fracture line. Figure 15, of the same date, shows the fracture of the left mandible reduced and immobilized; also, a screw in position on each side of the fracture line. Figure 16 shows the teeth in occlusion after reduction and immobilization of the badly displaced fractures. Figure 17, of the

same date as Figure 16, shows the four screws and fixation bar in position.

CASE 6.—*History.*—M. J., a colored man, aged 49, healthy, well-developed and well-nourished, a railroader by occupation, admitted to Hines Hospital March 25, 1943, for treatment of a jaw injury received one week before when he was slugged on the lower jaw region, stated that he had suffered considerable discomfort and pain in the region of the lower jaw since the time of injury. He also stated that he had been unable to masticate food or close his teeth. No other complaints were registered.

Examination.—The patient was brought to the oral surgery department in a wheel chair March 27. Extensive swelling of the submaxillary region was present. Intra-oral examination revealed a full complement of teeth present. The right side of the mandible was pulled downward by the suprahyoid muscles and there was clinical evidence of a compound fracture of the mandible in the region of the left lateral incisor tooth. The fractured parts were extensively separated and pus was escaping intra-orally from the fracture area. The right lower teeth were

Fig. 15 (Case 5).—Fracture appliance in position with patient's mouth open. (April 7, 1943.)

Fig. 16 (Case 5).—Fixation appliance in position and teeth in occlusion. (April 7, 1943.) The patient could masticate food well during the treatment period. The fracture of the mandible was compounded and was about 1 cm. to the left of the symphysis region.

Fig. 17 (Case 6).—Fracture of left mandible, with two screws in position, one on each side of fracture. (March 3, 1943.) A puncture was first made in the desired position, extending to the bone. A hole was then drilled into the bone and a screw was placed in the prepared hole.

Fig. 18 (Case 6).—Two screws in position in right mandible, one screw on each side of fracture line. (March 3, 1943.)

below the line of occlusion about 1 cm. when the patient attempted to close the teeth. A roentgenogram of the mandible also revealed fracture in the jaw area.

Operation.—Under local anesthesia, March 29, the fractured parts were reduced to normal position and immobilized. Four pins, two on each side of the fracture line, were placed extra-orally in the mandible. Each pair of pins was placed in a crossed position. The sharp end of each pin punctured the skin and muscle in the desired position until bone was encountered, then were driven into the bone by the aid of a hand drill, a distance of about 1.25 cm. The pins and cross attachment plates used in this case were like those used in Case 4. However, the fixation bar was a little different, in that the straight end of this bar was threaded for a distance of about 2.5 cm. and a nut to fit these threads was prepared. After the cross

Fig. 19 (Case 6).—Immobilization appliance in position and teeth in occlusion.

attachment plates were attached to the pins and the fracture had been reduced as nearly as possible by manual manipulation, the ends of the fragments were not in apposition. The fixation bar was then attached to each cross plate and, by turning the nut on the threaded end of the bar, the separated parts were easily pulled together, normal occlusion finally being obtained, which is a good criterion to follow in reducing jaw fractures and immobilizing the fragments. The fixation bar was securely locked. Later, adjustments may be made during the immobilization period if indicated. The loose lower left lateral tooth in the line of fracture was removed at the time of operation. More often than not, teeth in the line of a fracture should be removed. Surgical judgment must be used in each case.

After-Care.—The dressing of the area and application of sulfonamide to the region where the pins entered the skin were similar to those of Case 5, except that the procedure was followed daily during the treatment period of Case 6 and only every two days in Case 5. It will be noted that infection of the fracture area was present on admission to hospital, with pus draining from the fracture area intra-orally. Medication for relief of pain consisted of administration of one-sixth grain of morphine two hours after operation and one-half grain of codeine every eight hours thereafter for four days. Because of the infectious process in the fracture area, 1 gm. of sulfadiazine was administered every six hours for the first four days after operation and thereafter every six wakeful hours for five weeks, at which time drainage had ceased. The drug was administered by mouth.

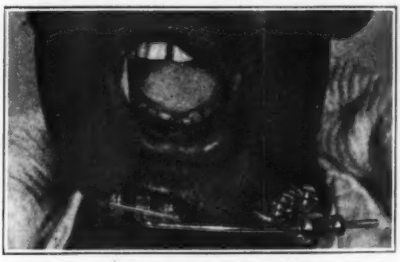

Fig. 20 (Case 6).—Patient with mouth open. The rubbr band used for tension can be seen here.

The patient was placed on a soft diet for the first four days after operation and thereafter was on a regular diet. To make it easier for the patient to close the teeth in normal occlusion, a wire hook was attached to each upper and lower left cuspid tooth a few days after operation and a small rubber band was placed over each hook. This slight elastic tension in no way interfered with the normal movements of the mandible and the patient was still able to masticate food. This elastic tension was discontinued after two weeks.

Outcome.—The fracture healed and apposition of the fractured parts was obtained, also normal occlusion. Under local anesthesia, the appliance was removed six weeks after insertion.

Comment.—Figure 18, under date of April 17, 1943, is a roentgenogram of the mandible showing the four pins in position, in pairs on each side of the line of fracture. Each pair of pins was inserted in a crossed position. The pins were placed approximately 1.5 cm. from the fracture line. Figure 19 shows the immobilization appliance in position and the teeth in occlusion. Figure 20 shows the patient with his mouth open. The rubber band previously mentioned is seen here.

SUMMARY

Six cases of fracture of the mandible were recently treated at the U. S. Veterans Hospital, Hines, Ill., by the extra-oral utilization of screws or pins. All of the patients presented compound fractures. In three cases, the fractures were bilateral and in three they were unilateral. One of the patients was completely edentulous, one had an edentulous upper arch and the others had teeth in both arches. Five of the fractures were reduced and the parts immobilized under local anesthesia. Pentothal sodium was used in the other case.

Vitallium screws, used as anchor posts, were inserted extra-orally in the mandible, and three of these patients had bilateral fractures. In these three cases, four screws were inserted in the mandible, one on each side of the fracture line, and, in the unilateral fracture, two screws were inserted on one side of the fracture line and one screw on the other side. With surgical cleanliness, a stab wound was made at the desired position through the skin and muscle until bone was encountered. A drill a little smaller in diameter than the screw to be used was placed in this incision and a hole was drilled into the bone to a depth of approximately 1 cm. A screw was then placed in the prepared hole. As many screws as desired were likewise placed in the mandible. A fixation bar was cut the proper length and bent approximately to the desired position. Then the fractured parts were placed in the desired position and the prepared fixation bar was attached to the exposed ends of the screws.

Pins were forced into the mandible extra-orally to serve as anchor posts in two cases of unilateral fracture of the mandible. The sharp end of each pin was pushed through the skin at the desired point and the pin forced through the muscle until bone was encountered. The pin was then driven into the mandible for about 1 cm., or deeper. Four pins were placed in the bone in each case and the pins were placed in pairs on each side of the fracture line. In one case, the pins were forced into the bone by the aid of an impactor. A hand drill was used to force the pins into position. Each pair of pins was placed in the bone in a crossed position in one case. After all pins were inserted in the bone, each pair of pins were attached together by fastening a cross attachment plate to them. The fractured parts were reduced and a fixation bar was attached to both attachment cross plates, thus immobilizing the parts.

The immobilization period for the six cases reported here was four and a half weeks. The percentage of undesirable complications was no higher among this group than in other groups treated by other recognized methods. The patients were able to move the mandible normally and masticated their food without discomfort during the treatment period. The pins or screws should enter the skin as near the lower border of the mandible as is practicable. The pins should not be placed too near root ends of teeth and should be as far from the line of fracture as is practicable. Scars following removal of appliances soon disappear.

BIBLIOGRAPHY

1. ANDERSON, R., and FINAYSON, B. L.: Sequelae of Transfixation of Bone. *Surgery*, 12:46-54, January 1943.

2. CONVERSE, J. M., and WAKNITZ, F. W.: External Skeletal Fixation in Fractures of Mandibular Angle. *J. Bone & Joint Surg.*, 24:154-160, January 1942.

3. MOWLEM, R., *et al.*: External Pin Fixation for Fractures of Mandible. *Lancet*, 2: 391-393, October 1941.

4. GRIFFIN, J. R.: Treating Fractures of Mandible by Skeletal Fixation. *Am. J. Orthodontics*, 27:364-376, July 1941.

5. LOGSDON, C. M.: Fractures of Maxillae and Mandible. J.A.D.A., 27:389-392, March 1940.

6. *Idem:* Utilization of Vitallium Appliance to Treat Edentulous Mandible Fractures. J.A.D.A., 29:970-978, June 1942.

VERTICAL DIMENSION IN COMPLETE DENTURE PROSTHESIS

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IF vertical dimension in complete denture prosthesis were only a matter of establishing normal face height, it would be reasonable to consider the vertical relation in which the ridges are mounted as a "position of reference," because, if a change in vertical height would place some mechanical phase in a more favorable position, it would be logical to sacrifice a few millimeters of ridge separation.

But in changing the height of the ridge separation, which would establish the normal vertical dimension, we do far more than alter the face height: we also change the length of the muscles, thus preventing the normal performance of the highly complicated musculature of the jaws, lips, tongue, etc., which require coordination and balance to perform their many functions in an efficient manner. This interference will sooner or later manifest itself in the performance of the dentures, and we will become convinced that the physiologic influence is more dynamic than the mechanical.

Vertical dimension is the dimension present in a very definite mandibular position, and it has been correctly established when the edentulous ridges have been recorded in a relationship that places the mandible in the exact relation to the maxillae that existed when the natural teeth were held in centric occlusion. To establish this relation, consideration must necessarily be given to certain other closely associated mandibular positions.

When we depend on the coordination that normally exists between the musculature of the jaws and certain physiologic functions, such as speech and deglutition, to place the mandible in these selected normal positions[1] we must be certain that the method of recording the positions is synchronized with the physiologic function, even when the musculature performing the function has, because of abnormal habits, formed an incorrect behavior pattern.

In establishing the vertical dimension, the ridges must be correctly related in both the vertical and the horizontal plane. If the muscles that control jaw movements in both of these planes have normal behavior patterns, they will cause the registration to be made with a normal degree of vertical separation between ridges that are in centric horizontal relationship.

On the other hand, it will be found that an incorrect muscular behavior pattern has been created during the period

1. HARPER, R. N.: Vertical Dimension in Complete Denture Prosthesis. J.A.D.A. 29: 762, May 1942.

of the gradual loss of the teeth, because it became necessary to perform certain physiologic functions, such as mastication and deglutition, with the jaws in abnormal relationship in the horizontal plane. This muscular pattern control will cause the registration to be made with the mandible in protrusion, a relationship known as "functional centric relation"; but as the position of the mandible does not coincide with the position that it occupied when the natural teeth were in centric occlusion, the record, as far as centric relation is concerned, will be faulty and must be corrected.

In other cases, it will be found that an incorrect muscular behavior pattern has been created by malocclusion, wherein the patient habitually swallows with a suction action of lips and tongue, with the teeth separated. This will cause the registration to be made before the mandible has reached its normal vertical dimension, resulting in an error in the vertical relationship. When the mandible does not automatically return to its rest position after the registration is made, we should suspect an abnormal swallowing habit.

The orthodontist who not only corrects such cases of malocclusion, but also teaches his child patient to perform functions associated with the jaws in a normal manner, is performing a service to each patient, the benefits of which do not cease with the loss of the teeth. And, as prosthodontists become more conscious of the influence of muscle dynamics in complete denture prosthesis, they will become more appreciative of the assistance they are receiving from the orthodontists.

The technic itself can cause a physiologic function, with a normal muscular pattern, to perform in an abnormal manner and thereby register an incorrect relationship. Just as a match or pipestem held between the teeth will enable one to swallow with ease while the mandible is below its normal vertical position, so will the recording material, if it is not soft enough, furnish a "grip" for the muscles, permitting function before the mandible has reached its normal vertical position. To be certain that the material does not furnish such a grip or interfere in any way with the normal actions, we must make two records. The first, as it is made on a plane just below the normal vertical dimension, enables us to remove all excess material and to alter the heels of the baseplates, if they are liable to cause interference with the second record. For this record, we use the M sound, as it places the mandible very close (from 1 to 7 mm.) below its normal vertical position and it has a muscular control pattern that is always normal. We must also measure and record the height of the initial record, as the normal overbite is to be determined by a comparison of the height of the two records.

In order for this preliminary record to be further prepared for the final or swallowing record, it must be placed in hot water, so that the material will be uniformly soft. For this to be done without softening of the baseplate, the initial record must be removable from the baseplate. It is also necessary that the record be replaced in the original position and that the material be protected from collapsing. All of this is accomplished by the use of metal trays held in place by metal retainers attached to the lower baseplate.

For a number of years, including some time after using the detachable tray method, I considered the vertical relation in which the ridges were mounted as a position of reference, and continued to change the degree of ridge separation in an effort to obtain the mechanical ideal.

After the cases in which the degree of ridge separation has been obtained by the detachable tray method and then changed had been worn for a time, it

became evident that the original space should not have been altered. It was then decided to build the next ten cases without making any changes in the intermaxillary space established by the detachable tray method, regardless of the relationship and positions of the phases that had previously caused me to make changes. The following is a report of the findings as summarized from the recordings that were made during the construction of each case.

All cases were constructed by the technic described in a previous issue of THE JOURNAL, with the addition of a new method of mounting the table on which a gothic arch tracing is recorded, and the method of obtaining a record of the corrected centric relation when the horizontal relation in which the ridges are mounted does not coincide with the apex of the tracing.

Fig. 1.—Bi-record device constructed so that tracing record can be made on table and, when necessary, centric relation can be recorded in trays. Because of the support offered by the record trays, it is possible to use recording material as its most favorable consistency.

In this new method, we remove the trays with the vertical dimension record intact and then mount a bi-record device, composed of two record trays and a tracing table. (Fig. 1.) The device is held together and correctly placed in relation to its associated parts, for each individual case, by simply setting the trays in their retainers and then attaching the tracing table. This table is easily removed by means of a posterior adjustment tap.

This second set of record trays are made so as not to interfere during the process of making a tracing, and if a correction in centric relation is necessary, it will be taken in the trays and the record will be clear cut and with a minimum amount of pressure, because of the deep body of compound that has been correctly placed.

A gothic arch tracing is made in the mouth, and if the apex coincides with the horizontal relation of the mounted cases, the relationship is accepted. If not, the trays are filled with soft compound into which the patient closes the jaws so that the tracing pin rests in the apex of the tracing. The lower model, when remounted, maintains the original vertical ridge separation, but with a different horizontal relation, which is now the correct centric relation.

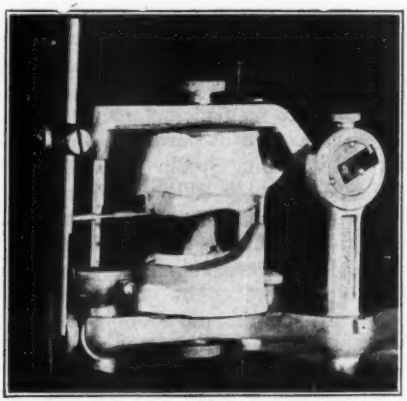

Fig. 2.—Device that, while homemade, proved to be adaptable and sufficiently accurate in measuring degree of ridge separation and in determining proportionate division of space by occlusal plane. It is also used to determine the parallelism of the ridges to each other and to the horizontal plane.

This gives us two records for consideration, which place the mandible in the same vertical, but different horizontal relationships. The first places it forward to the normal and is the functional centric relation record. The second places the mandible in its normal relationship and is therefore the true centric relation record. When the two horizontal relationships of the mandible coincide, as they do in a number of cases, the functional centric relation becomes the true centric relation.

In the ten test cases, the amount of overjet used ranged from 1 to 6 mm., with an average of 3.9 mm. It was noted that, in three cases, the distance from the apex to functional centric position was approximately the same as the amount of actual overjet. In the other cases, there was no similarity. The conclusion might be drawn that the first three, because of the similarity of length between true centric and functional centric position, were under the control of incorrect muscular behavior patterns, owing to prolonged abnormal functional use of the anterior teeth. The others, because of the ease with which they closed into true centric position, after the anterior teeth were set up, could have been due entirely to abnormal swallowing, either acquired or produced by strain during the registration. The last should have been noted by the operator. Contrary to expectations, there was nothing evident in the final results to indicate that the cases in which the two horizontal relationships coincided were any more efficient than those that were corrected.

That the unfavorable results were not evident, even during the time that the muscular patterns of these cases were in the process of correction, was due to the method of recording the protrusive position of the mandible in both planes, while the muscles of the jaws were in balance for normal incisal function.

The technic requires that the anterior teeth be set with the amount of overbite, which is determined by differences in vertical mandibular elevations, obtained during the process of registering vertical dimension, and by the amount of overjet, which is determined by the distance that the mandible travels in the horizontal plane from centric to normal incisal contact. Under instruction, the patient bites on the incisal edges and the position is registered in the record trays. To supply balance for such an arrangement of the anterior teeth, as well as compromise for our inability to reproduce normal lateral movements, and also to compensate in some degree for the normal and pathologic changes that will occur in the supporting ridges, we used in all cases a simplified posterior arrangement. The main feature of this arrangement was the use of cuspless teeth, set to an occlusal plane free of curves, except for the inclination of the lower second molar to balance the incisal occlusion. In some cases, the upper second molar was eliminated; if not, it was set entirely out of occlusion. The maximum contact in centric occlusion was placed on the first molars and second bicuspids.

This occlusal combination gave every indication of harmonizing with mandibular positions that were normal or abnormal, as well as being a means to encourage the abnormal functional positions to return to normal.

There are cases, due to malocclusion, in which no muscular pattern has been formed to control the position of the mandible for the incisal bite and, as a result, the patients, when they become edentulous, are unable to register a normal incisal relation. It is also to be noted that, in these cases, as well as the end-to-end anterior centric occlusion cases, the mandible does not protrude in function beyond centric occlusion. Therefore, when such cases are treated for dentures, it will not be necessary to register the protrusive incisal relation.

The safest way to prevent complications in the construction of dentures for

the cases with abnormal incisal functions, as well as abnormal incisal relations in centric occlusion, is to know the natural habits and occlusion of each denture patient. We can obtain this information by testing for normal incisal functions before the teeth are extracted and can record it on the back of the anterior centric record model.

In ten consecutive cases, the degree of ridge separation, as determined by the vertical dimension records, was very carefully measured with the device shown in Figure 2. The measurements were made from a point just to one side of the incisal papilla to a point directly under and on the crest of the mandibular ridge. The degree of ridge separation was found to range from 20 to 28 mm. There was one case each with 20, 21.5, 22.5, 24, 24.5 and 28 mm.; two cases with 21 mm., and two cases with 26 mm. of ridge separation; an average of 23.4 mm.

As the incisal edges of the natural upper central incisors are approximately the length of the lip, and rest on an imaginary plane which, when extended, coincides with the areas of occlusion, establishing the occlusal plane, this plane divides the normal vertical dimension in equal parts. Therefore, if the artificial upper central incisors are placed in the same vertical relationship to the lip, the anterior portion of the occlusal plane has been correctly located, and if the distance from the crest of the ridge to the incisal edges equals one half of the total ridge separation, two definite conclusions can be drawn: 1. The amount of resorption in the anterior region of the upper and lower ridges has been equal. 2. The degree of the ridge separation is normal.

In six (ridge separations ranging from 21 to 26 mm.) of the ten cases, the distance from the ridge to the incisal edges was equal to one half the degree of ridge separation. Therefore, we can draw the conclusion that the resorption in these cases was equally divided between the upper and lower ridges and that the vertical separation in each case was normal.

The average distance in the ten cases, from the crest of the maxillary ridge to the incisal edges of the central incisors, was 10.8 mm., ranging from 9 to 13 mm. It was also noted that, in these cases, the average length was only 0.9 mm., less than one half the average distance (11.7 mm.) of ridge separation.

However, in four cases, the occlusal plane did not divide the degree of ridge separation in equal parts. In three of these cases, there was excessive resorption of the lower ridges. The amount of difference in the division ranged from 2 to 6 mm. To compensate for the unequal division, it would be necessary to change the degree of ridge separation in each case, but in the belief that the established vertical dimensions were correct, no changes were made. The final results substantiated this belief.

Therefore, the conclusion can be drawn that when the established vertical dimension is correct and the occlusal plane correctly located, the unequal division of the denture space by the plane does not affect the results, even though the height of the lower denture above the ridge has to be increased to an amount equal to the excessive resorption.

If posterior ridge parallelism is also considered a means of determining the correctness of individual vertical dimension, there should be in all established denture space a uniformity of correlation between parallel ridges and equal division of the intermaxillary space by the occlusal plane; that is, if the posterior ridges are parallel, the occlusal plane should divide the intermaxillary distance in equal parts, or vice versa.

In a comparative study of the chart, it was found that in only two out of seven cases was there any uniformity of relationship. In one case, the plane divided the space in equal parts and the posterior ridges were parallel. In the other case, the plane did not equally divide the

space and the ridges were not parallel. In the other cases, if the space was equally divided, the ridges were not parallel, or vice versa. Therefore, we cannot determine the correctness of the vertical dimension by the position of the plane or by the parallelism of the posterior ridges.

It is also to be noted that in only three of the seven cases were the posterior ridges parallel, and yet the results were equally satisfactory. Therefore, if muscular balance is present, the results do not seem to be affected by the presence or absence of parallel ridges.

However, it was found that a uniform correlation did exist between the relationship of the posterior sections of the maxillary ridge to the horizontal plane and parallelism of the upper and lower posterior ridges. When the right and left posterior sections of the maxillary ridge rested on the same horizontal plane, they were also parallel to the mandibular ridges. When the posterior sections of the maxillary ridge did not rest on the same plane, the maxillary posterior ridge was not parallel to the mandibular posterior ridge. The same is true when the anterior and posterior sections of the maxillary ridge do not rest on the horizontal plane.

In contrast, during the process of mounting the record trays, it was found that the mandibular ridge was almost constant in its parallelism to the horizontal plane. Therefore, it is apparent that the deciding factor in ridge parallelism is the relationship of the maxillary ridge to the horizontal plane and not the height of the vertical separation.

Just as there is only one mandibular position of rest, so there is only one mandibular position for any given speech sound. The exactness and strict accuracy of repetition of these positions, regardless of whether the teeth are present, is a remarkable example of muscle dynamics.

In this discussion, we are interested only in those sounds that produce mandibular positions above the rest position; such as, the M and S sounds. When either of these letters are sounded, the vertical separation between the anterior teeth is the same. The M sound is used in the registration technic, because it produces lip contact. The S, or a combination, as in Mississippi, is used in checking the correctness of the individual vertical dimension, as it causes the lips to separate, enabling us to see whether the vertical separation of the artificial anterior teeth is normal or abnormal.

When the lips contact on making the M sound, there is, in every case, with the exception of a few abnormal ones, about 1 mm. of vertical separation between the upper and lower anterior teeth, while, in each case, the amount of separation between the posterior teeth varies. We are, therefore, faced with a constant degree of separation between the anterior teeth in all cases, but with a variance in the degree of separation between the anterior and posterior teeth in the individual case, as well as a variance in the degree of separation between the posterior teeth in different cases.

The uniformity in comparative length of the anterior teeth and the lips accounts for the constancy in the anterior separation.

The lack of comparative lengths of the anterior teeth and vertical dimension accounts for the difference in degree of separation between the anterior and posterior teeth in the individual case.

The difference in the height of vertical dimensions in individuals accounts for the variances in the degree of separation between the posterior teeth in various cases.

To compensate for these variations when the teeth are closed in centric relation, Nature created the overbite, the degree of which equals the amount of variation in the individual cases.

Applied to our technic of registering vertical dimension, this means that the difference between the height of the M

sound record and the vertical dimension record, less the 1 mm. of anterior speech clearance, equals the normal overbite. Reduced to a simple formula, it reads:

Overbite=M sound record—vertical dimension record—1 mm.
O=M—V—1 mm.

The overbites obtained by the application of this formula, in fourteen cases, ranged from zero to 4 mm., with an average of 1.8 mm.

The cases in which exceptions exist to the 1 mm. of anterior separation are the ones in which the degree of overbite is from 8 to 10 mm. and the total length of the anterior teeth is greater than that of the lips. Also, in the ones in which the overbite is of a minus degree or "open bite," and the anterior teeth are shorter than the lips, I am convinced, though it has not been proved, that the abnormality in these cases is not due to a lack of normal proportionate length of the anterior teeth, but to a lack in a normal proportionate height of the vertical dimension. If the natural vertical dimension in a case is less than its normal proportion of the face height, the teeth will be longer than the lips; and if it is greater than its proportion, the teeth will be shorter than the lips.

The same condition exists in artificial dentures. In a given case in which the natural overbite has been reproduced and an incorrect vertical dimension recorded, the teeth will be too long or too short, in comparison to the lips, the dimension depending on whether the vertical dimension was decreased or increased beyond normal.

It will also be found that when the S, as in Mississippi, is sounded and the variation in the degree of separation between the artificial anterior and posterior teeth is not equal to the amount of overbite, the height of the vertical dimension is incorrect. Whether the variance is greater or less will be indicated in the increase or decrease over the normal 1 mm. of vertical separation between the anterior teeth.

In one case, the overbite, arrived at by the application of our measurements to the formula, was 4 mm. The anterior teeth were the approximate length of the lips, and when the S was sounded, there was about 1 mm. of clearance between the upper and lower anterior teeth. The variation in the degree of separation between the anterior and posterior teeth, therefore, equaled the overbite.

All ten cases passed this test, and we feel justified in asserting that when these patients closed the jaws in centric occlusion, the individual normal vertical dimension had been restored in each case.

GENERAL ANESTHESIA UNDER WAR CONDITIONS

W. HARRY ARCHER,* B.S., D.D.S., Pittsburgh, Pa.

THE needs of general anesthesia under war conditions mean that suddenly we must train hundreds of individuals to administer general anesthesia to patients both in the armed forces and on the home front. The Medical Division of the Office of Civilian Defense has urged that dentists prepare themselves to act as anesthetists for emergency surgical teams, who may suddenly have to care for hundreds of casualties as a result of local catastrophes due to bombings or sabotage. To supply this need in a minimum of time, these persons must be taught the use of drugs whose application does not require a prolonged course of instruction in order to develop a high degree of skill; nor must they require elaborate complicated machines. Simplicity and standardization of anesthetic methods are the pleas of the anesthetists already in the field.[1, 2]

The requirements for drugs that have to meet this need may be summarized as follows: 1. Relative safety. 2. Simplicity of technic. 3. Speedy effectiveness. 4. Easy maintenance. 5. Quick, uneventful recovery.

In addition to the specific requirements of the agent, the following requirements must be met in order for it to be a satisfactory agent for military use: 1. Easy transportation. 2. Ready availability. 3. Simplicity of equipment.

Fortunately, there are available anesthetic agents that go far toward meeting these requirements: 1. Ether (inhalation). 2. Pentothal sodium (intravenous). 3. Procaine (spinal, regional or infiltration).

The first two only will be discussed in this paper.

Before the administration of agents which cause loss of consciousness, the embryo anesthetist must know how to prepare a patient for anesthesia. Preanesthesia preparation of a patient consists of: 1. An interview with the patient, covering name, age and previous anesthetic experience. 2. Administration of sodium amytal 3 grains the night before the operation. 3. An enema the night before. 4. Emptying of the stomach before operation (no breakfast). 5. Emptying of the bladder. 6. Removal of partial or full dentures from the mouth. 7. One half hour before operation, subcutaneous hypodermic injection of morphine one-sixth grain and atropine one one-hundred-fiftieth grain. If time is a factor, these drugs can be administered intravenously, one-eighth grain of morphine and one one-hundred-fiftieth grain of atropine. The morphine is to allay fear and apprehension, and hence avoid psychic trauma. The atropine is to minimize secretion. The administration of atropine is also thought to be an effective preventive of laryngospasm, which is sometimes seen during the use of pentothal sodium intravenously.

Of course, if the anesthetic is to be given for an emergency operation, as would frequently be the case after military action, it will be impossible to carry out all these points, because the clearing hospital would be jammed with men requiring immediate operation.

There has been considerable discussion about the use of barbital derivatives to

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prevent shock,[3] and it may be that, at the first aid station, one of the forms of this drug has been administered to the wounded. This appears to be a very desirable procedure, both to help prevent shock and as preanesthetic medication. The patient still should have morphine and atropine prior to actual operation, for the reasons already stated.

Drop ether, which Kaye[4] says is "probably the best 'standard' anesthetic for military use," has been extensively used in combat areas in this war. It comes close to fully meeting the requirements that have been enumerated.

The "open ether" method means the administration of ether for surgical anesthesia by dropping the liquid ether on a gauze mask over the patient's nose and

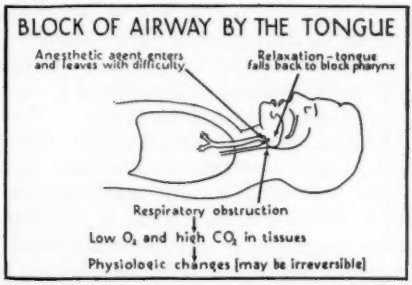

BLOCK OF AIRWAY BY THE TONGUE
Anesthetic agent enters and leaves with difficulty
Relaxation - tongue falls back to block pharynx
Respiratory obstruction
Low O_2 and high CO_2 in tissues
Physiologic changes [may be irreversible]

Fig. 1.—Common cause of mechanical respiratory embarrassment. (Courtesy American Medical Association.)

mouth, the mask being so constructed as to permit an unrestricted interchange of ether vapor and air between the lungs and the external air. This method depends on the normal respiratory excursions to carry the ether vapor into the lung alveoli, where the ether vapor passes into the capillaries, then to the heart, then to the body and brain. It is absolutely necessary at all times to make certain that the patient has a free or open airway, regardless of the type of anesthetic.

Figure 1 shows a common cause of mechanical respiratory embarrassment in the form of the relaxed tongue falling back into the pharynx. This can be relieved by inserting a pharyngeal airway. (Fig. 2.)

Another frequent source of mechanical respiratory embarrassment is mucus, blood or vomitus in the pharynx or over the larynx. (Fig. 3.) It is advisable, whenever possible, to have a suction apparatus available during the administration of anesthetics.

The Ferguson open drop method is

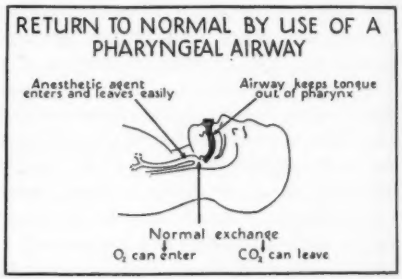

RETURN TO NORMAL BY USE OF A PHARYNGEAL AIRWAY
Anesthetic agent enters and leaves easily
Airway keeps tongue out of pharynx
Normal exchange
O_2 can enter
CO_2 can leave

Fig. 2.—Respiratory embarrassment from tongue dropping into pharynx relieved by pharyngeal airway (not to be used with intravenous anesthesia). (Courtesy American Medical Association.)

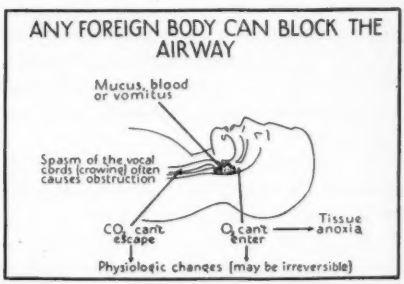

ANY FOREIGN BODY CAN BLOCK THE AIRWAY
Mucus, blood or vomitus
Spasm of the vocal cords (crowing) often causes obstruction
CO_2 can't escape
O_2 can't enter
Tissue anoxia
Physiologic changes [may be irreversible]

Fig. 3.—Large blood clots in pharynx as result of leakage around poorly placed oropharyngeal partition during oral operations. (Courtesy American Medical Association.)

safest for the patient and the most economical. This method will be described in detail.

The Ferguson mask frame is made of readily flexible wire, which permits it to be molded with finger pressure to conform to the contour of the patient's face.

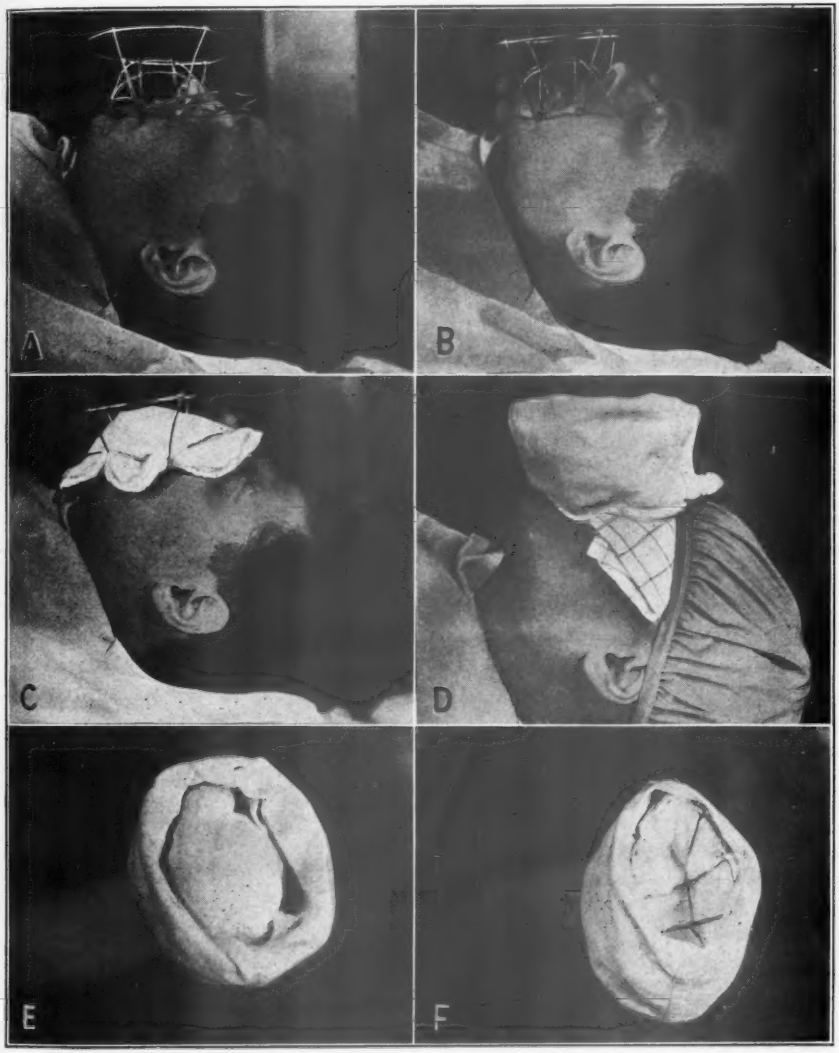


Fig. 4.—A, wire frame improperly adapted to patient's face. B, Frame work properly adapted. C, convex portion covered with six layers of surgical gauze. D, whole frame covered with Canton flannel hood. E, upper chamber; ether dropped on convex portion. F, lower chamber, fitting over patient's face.

When the mask is so fitted, it is possible to prevent air from entering between the face and the mask; hence, all the inspired air must pass through the gauze holding the liquid ether.

Since the face wire, and the convex portion, are made of very flexible wire, the fitting can be easily done by bending the wire between the fingers. Figure 4, A shows a side view of the wire frame

resting on the patient's face, but not adapted to the contour of the face. The frame in Figure 4, B has been properly contoured to the patient's face. If the face is long and narrow, the inhaler is lengthened by pulling at both ends. If the face is broad, the inhaler is widened by pulling on the sides.

Over the convex portion, from six to ten layers of surgical gauze (twenty threads to the inch) may be stretched and held taut in position by a flexible wire. (Fig. 4, C.) The whole is covered with a Canton flannel hood so made that it can be drawn up closely against the flexible face wire. (Fig. 4, D.) In this way, two chambers are formed, in the upper of which (Fig. 4, E) the ether and air become mingled, while the patient inhales the mixture from the lower one. (Fig. 4, F.)

ADMINISTRATIVE DEVICE

The ether should be used in the original can. In order to form a suitable drop, a wick should be used. To make the wick, one takes a piece of standard bandage gauze 1 inch wide and three or four times the depth of the can in length. The gauze is folded once to bring its two ends together, the two halves lying loosely and not flat in contact. Holding one end firmly in one hand, this doubled strip is twisted into a firm wick and introduced into the can to its bottom, about one-half inch projecting beyond the mouth of the can. The mouth of the can is then closed with an ordinary cork, one having shallow slits cut in it, and the wick firmly pressed between the cork and the neck of the can. If the cork is put in tightly enough, it cannot be shaken out, nor can the wick be drawn out, and when the can is tipped, no ether will run out of it. Nevertheless, if this can, with the wick in it, is held upright and then tipped a little, drops of ether will come from the end of the wick, very slowly at first, but more rapidly as the can is tipped more and more. Under no circumstances will the ether run out in a stream if the wick has been properly prepared and inserted. (Fig. 5.) Also shown in Figure 5 is a pipe cleaner which is being used as a wick. A safety pin passed through the cap will also serve to form drops.

ADMINISTRATION OF THE ETHER

Ether is very irritating to the eye and care must be taken to prevent conjunctivitis. The following procedure has proved to be very satisfactory at the Eye and Ear Hospital.

1. A sheet of rubber dam, notched for the nose, is laid over the eyes. (Fig. 6, A.) 2. The rubber dam is covered with a towel. (Fig. 6, B.) 3. A rubber cap covers the head and holds the towel and rubber dam in place. (Fig. 6, C.)

Fig. 5.—Different methods of dropping ether. The two illustrations on the left show the wick in the can as described; next is a pipe cleaner, and on the right is a safety pin passed through the cap.

4. The dam is lifted and olive or mineral oil is dropped into each eye. (Fig. 6, D.) (To observe eye symptoms, the dam and towel can readily be lifted).

The apparatus, ready for use, is laid gently over the face of the patient. If it is properly fitted, no air will pass between the face of the patient and the inhaler, but all will go in and out through the opening. The patient is allowed to breathe through the inhaler, in order to feel that the respiration will not be embarrassed.

Because of the pungency of ether vapor and its irritating qualities as regards the laryngeal mucosa, the patient

should first be anesthetized with ethyl chloride (Fig. 7 A) or vinyl ether, ether being then added to the mask freely and without interruption to maintain surgical anesthesia. In combat areas, this probably will not be possible; hence, the following technic should be used:

A drop of ether is allowed to fall through the opening onto the gauze. In two or three seconds, another drop is allowed to fall, this process being repeated several times. (Fig. 7 B.) The patient is asked to count out loud. Soon it will be found that the mucous membrane of the respiratory passages is sufficiently anesthetized to be tolerant of the ether, and then the dropping may become more frequent; which is accomplished by tilting the can more. The rapidity of the dropping must be learned by experience. Usually, after the passages have become tolerant of the ether, about 2 or 3 drops a second will suffice to put the patient in a state of surgical anesthesia. The rate at which the ether drops should be such that the patient does not cough or struggle. If there has been too rapid administration of ether, frequently the patient will hold his breath. This should be corrected at once, by ceasing to drop the ether, but allowing the mask to remain on the face. There

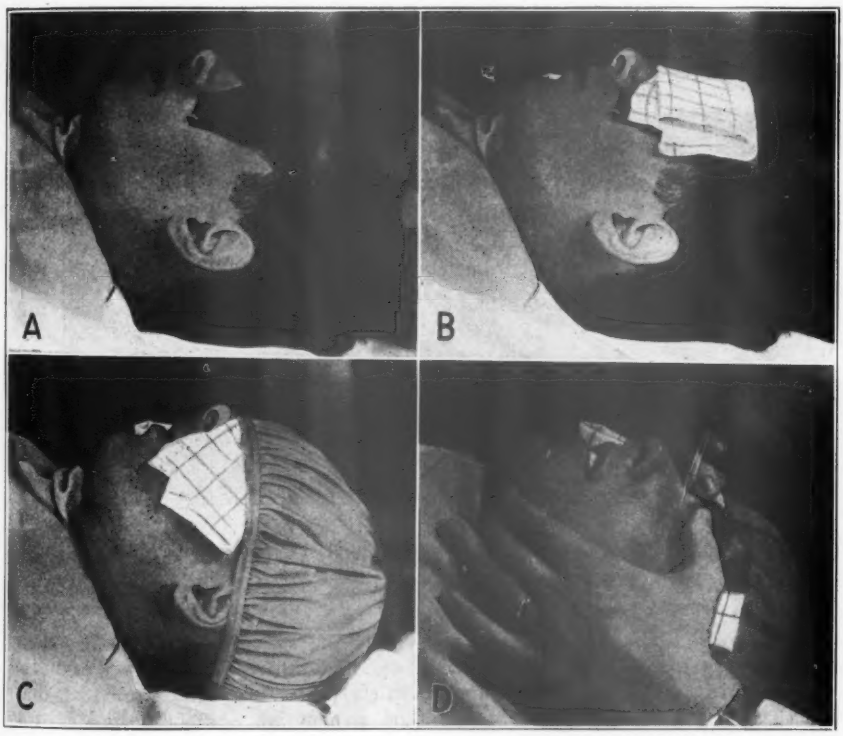


Fig. 6.—Measures to protect eyes. A, piece of notched rubber dam over eyes. B, rubber covered with towel. C, rubber cap covering head and holding towel and rubber dam in place. D, dam lifted and olive oil dropped in each eye.

are usually two reasons for this temporary cessation of respiration: (1) the patient is acapnic from hyperventilation or (2) the ether vapor causes irritation. Respiration will be resumed shortly and then the rate of administration should be reduced to the tolerance level. The surgical stage is reached when the patient exhibits those signs which are indicative of that stage. It is imperative that the anesthetist know thoroughly the signs and stages of anesthesia so as to be able to decide quickly how deeply the patient is narcotized. It takes time to produce a satisfactory plane of anesthesia and it is unwise to "push" the anesthesia in an attempt to shorten the induction period. To maintain the surgical anesthesia thus produced, the dropping should be continued, but as anesthesia proceeds and deepens, the dropping may be less frequent. The amount of ether necessary can be determined by observation of the operation. This is the duty of the anesthetist, not because of his interest in the operation per se, but in order that the anesthesia may be satisfactory. By keeping an eye on the operation and noting whether the reflexes remain abolished and the muscles relaxed, the anesthetist may so regulate the dropping as just to maintain a surgical anesthesia from which the patient will recover very quickly as soon as the inhaler is removed from the face.

When anesthesia is conducted in this fashion, so-called ether shock is reduced to a minimum; for the shock results not so much from the length of time the patient is under the ether anesthesia as from the amount of ether that he absorbs. Again, not only is recovery more speedy, but also it usually takes place with no vomiting, except perhaps to empty the stomach of mucus or blood swallowed during the operation, and also little or no nausea, always provided that the patient was suitably prepared for operation.

A B

Fig. 7.—A, position of hand, mask and can for drop ether anesthesia. B, anesthetization with ethyl chloride or vinyl ether.

It is recognized that soldiers have, as a group, dust-tobacco pharyngobronchitis[4] and may take ether badly, but, even in these cases, excellent results have been obtained with this instrument.

SIGNS AND STAGES OF ANESTHESIA WITH DROP ETHER

First Stage: Analgesia.—In this stage,

the patient retains consciousness, but the senses are dulled.

Respiration: There is no characteristic rhythm. Respiration is one of the most valuable guides as to the depth of anesthesia, as well as the most readily observed. It is imperative that the respiration be free and unobstructed at all times.

Pupil: The size of the pupil of the eye may be of value in determining the depth of anesthesia. However, it is influenced greatly by the kind and amount of premedication. In this stage, it may be dilated or contracted. In observing eye signs, both eyes must be watched. Care must be observed to avoid injuring the cornea.

Eyeball: No characteristic position or movement is noted.

Eyelid reflex: This reflex is observed by raising the upper eyelid with the finger. If the patient attempts to close the lid, the reflex is still active.

Color: The color is normal.

Muscles: The muscles are under voluntary control.

Second Stage: Delirium.—This stage is frequently referred to as the excitement stage. It is potentially a danger stage with any anesthetic and should be traversed as quickly as is consistent with good technic. Adequate preanesthetic medication will shorten the duration and reduce the untoward reactions seen in this stage.

Respiration: The respiration is irregular.

Pupil: The pupils may be slightly dilated owing to excitement.

Eyeball: The eyeballs are oscillating or eccentric.

Eyelid reflex: This reflex is active.

Muscles: Laryngeal movement and swallowing are observed. There may be activity of the skeletal muscles, sometimes of a rather violent nature.

Color: The color is normal.

Third Stage: Surgical Stage.—This stage is sufficiently broad to be subdivided into four planes.

First plane: Respiration: The respiration is rhythmical, with increased rate and depth, and is machine-like. This condition frequently develops with surprising abruptness and marks the onset of the surgical stage.

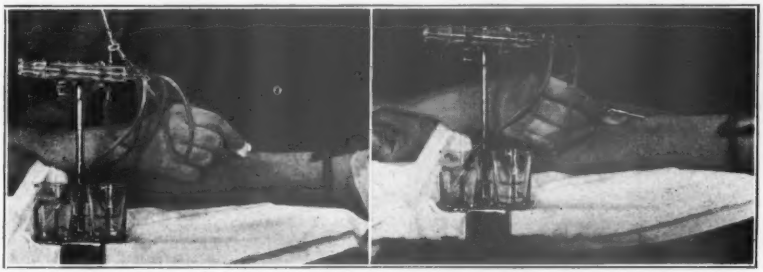
Pupil: The pupil is contracted. There is greater contraction with larger doses of morphine.

Eyeball: The eyeballs are oscillating or eccentric, with gradual cessation of movement as anesthesia deepens.

Eyelid reflex: This is inactive.

Muscles: The muscles are rigid. Swallowing and vomiting occur in the upper portion of this plane.

Color: The color is normal.



A B

Fig. 8.—A, hand clenched, tourniquet applied and skin scrubbed over vein with 70 per cent alcohol. B, skin tensed with thumb, for venipuncture.

Second plane: Respiration: The respiration is rhythmical (essentially the same as in the first plane).

Pupil: The pupil may start to dilate.

Eyeball: The eyeballs are centered and fixed.

Eyelid reflex: The eyelid reflex is inactive.

Muscles: There is incomplete relaxation.

Color: The color is normal.

Third plane: Respiration: The respiration is rhythmical, but decreased in depth because of paralysis of the intercostal muscles.

Fig. 9.—Insertion of needle in skin over vein. The tissue overlying the vein is moved to the side of the vein. The needle is then thrust into the tissue at the side of the vein. The needle point is returned to a position directly over the vein and the puncture is made.

Pupil: The pupils are dilated.

Eyeball: The eyeballs are centered and fixed.

Eyelid reflex: The eyelid reflex is inactive.

Muscles: There is complete relaxation.

Color: The color is normal.

Fourth plane: Respiration: There is extreme respiratory depression. The respiration may be gasping.

Pupil: The pupils are widely dilated.

Eyeball: The eyeballs are centered and fixed.

Eyelid reflex: The eyelid reflex is inactive.

Muscles: There is complete relaxation.

Color: There may be some cyanosis.

Fourth Stage: Respiratory Paralysis.—

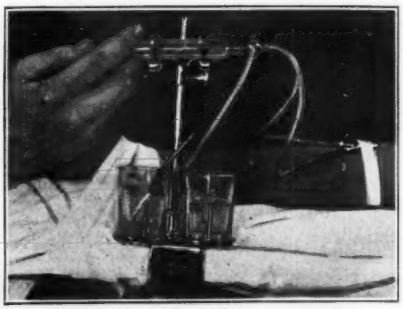


Fig. 10.—Needle held in vein by means of strip of adhesive tape over manifold and half way around arm. Injection of from 4 to 6 cc. of 2.5 per cent solution should require ten seconds.

Fig. 11.—Tissue paper "butterfly" as respiratory rate indicator.

This stage begins with respiratory failure and ends with death.

Respiration: There is continuation of respiratory depression, and finally cessation of respiration.

Pupil: The pupils are widely dilated.

Eyeball: The eyeballs are centered, fixed and lusterless.

Eyelid reflex: The eyelid reflex is inactive.

Muscles: The muscles are flaccid.

Color: The patient is cyanotic. It must be remembered that the color in cyanosis under ether anesthesia will not necessarily be of the blue-black character seen in nitrous oxide-oxygen anesthesia, but may be ashen. In a well conducted drop ether anesthesia, there should be no suggestion of cyanosis at any time.

TECHNIC FOR INTRAVENOUS ANESTHESIA

It has been predicted that "quick-acting barbiturates administered intravenously will be used more often than any other type of anesthetic agent" in war surgery.[3, 5, 6] Intravenous anesthesia with pentothal sodium is my first choice for exodontia and oral surgery in the hospital. This method of producing complete loss of consciousness seems to be particularly well adapted to war surgery. The equipment is simple, easily transported and readily obtainable. The drug is easily transported. It is put up as powder in a sealed glass ampule. If the content of a 1-gm. ampule is dissolved in the content of a 20-cc. ampule of sterile distilled water, we have a 5 per cent solution. If it is dissolved in 40 cc. of sterile distilled water, we have a 2.5 solution. Administration of the drug is easy and relatively safe, with a rapid induction period without delirium or excitement. The drug is non-irritating and non-explosive; which allows use of the cautery. While some authorities stress the opinion that intravenous anesthesia should be used only for operative procedures lasting from ten to fifteen minutes, in our experience some patients have been under anesthesia for as long as two hours, the average case lasting about an hour, without untoward effects. Thomas,[7] in reporting 10,000 cases of pentothal sodium anesthesia, writes, "The duration of anesthesia extended from three minutes to four and a quarter hours." This series has now reached 16,000 cases, and Thomas[8] now reports that "the operating time factor is not an important item in considering the selection of pentothal sodium as the anesthetic agent." Recovery is rapid and analgesia prolonged, with no postanesthetic complications such as nausea or vomiting, and no headache. Pentothal sodium anesthesia has a favorable psychic effect on anxious patients, and they do not fear future anesthesia with this method should additional operative procedures be required.

Fig. 12.—Administration of oxygen. Oxygen should be administered with every intravenous anesthetic. The nasopharyngeal airway is a satisfactory means. The tube is lubricated with petrolatum and passed through the nasal cavity into the pharynx and the other end is connected with a wash bottle connected with a tank of oxygen.

Preparation of Patient.—The stomach, bladder and rectum should be empty if possible. Morphine sulfate one-sixth grain and atropine one one-hundred-fiftieth grain is injected one-half hour before the operation. The operative field is prepared and draped. Everything is in

readiness for the operation. A tourniquet is applied to the upper arm and the patient is instructed to close his fist. The median basilic vein in the antecubital fossae or a dorsal metacarpal vein in the back of the hand is usually selected. In some cases, it may be necessary to use the saphenous vein in the ankle. The skin over the vein is prepared by scrubbing with a sponge saturated with 70 per cent alcohol. (Fig. 8 A.)

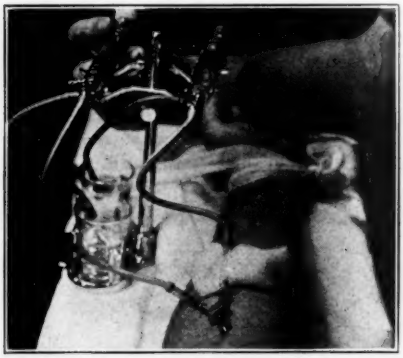


Fig. 13.—Thomas double syringe, intravenous outfit.

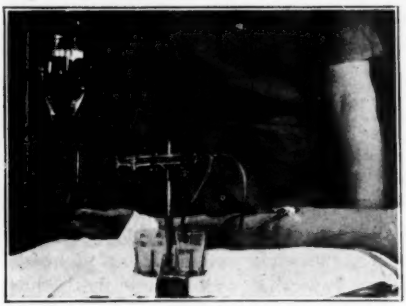


Fig. 14.—Method of injecting fluids during intravenous anesthesia.

For making the injection, a 10-cc. syringe is used, to which a 1¼ inch 20-gage needle is attached by means of rubber tubing. The skin is tensed and a venipuncture is made. (Fig. 8 B.)

The Technic of Venipuncture.—Step 1. The needle is inserted in the skin over the vein and the tissue overlying the vein moved to the side of the vein. The needle is then thrust into the tissue at the side of the vein. The needle point is then returned to a position directly over the vein and the puncture is made. (Fig. 9.)

Step 2. In large veins, the bevel of the needle is turned up. In small veins the bevel is turned down to avoid having the bevel lie partially in and partially outside the vein.

The venipuncture having been made,

Fig. 15.—Injection of fluids during intravenous anesthesia calling for connection of one side of manifold with the phleboclysis set.

a small quantity of blood is aspirated into the glass sight tube to make certain that the needle has entered the vein. (Fig. 10.) The patient is asked to count slowly and loudly. From 4 to 6 cc. of the 2.5% solution is injected in about ten seconds. The effects are closely observed. If the patient loses consciousness at the end of this small dose, he is susceptible to the drug and requires only small

amounts to maintain surgical anesthesia. The use of large amounts would cause marked respiratory depression. If no effect is noted, in other words if the patient continues to count beyond thirty seconds after the original injection, an additional 4 to 6 cc. is injected, with about ten seconds to inject this amount. As a rule, this additional amount is sufficient to produce unconsciousness, as indicated by the patient ceasing to count and subsequent relaxation of the jaw.

In an oral operation, the lips are coated with petrolatum, the Molt prop is placed to separate the jaws, a piece of gauze is placed over the upper and lower surfaces of the tongue and the tongue is grasped between the gauze surfaces by the fingers and drawn forward between the teeth. A double strand of 00 catgut, threaded in a tonsil needle, is passed through the midline of the tongue three-fourths inch from the tip. The suture material passed through the tongue should be long enough to permit four strands to extend at least 4 inches from the mouth. The needle is cut off and the ends of the four strands are tied together in a knot. A hemostat is clamped on the knot. This is the most efficient method of controlling the tongue, keeping it forward and out of the pharynx so that it is not a source of mechanical respiratory embarrassment. The suture is not removed from the tongue until the patient responds to questions. The patient does not have any soreness in the tongue afterward. Under pentothal sodium anesthesia, metal or hard rubber airways extending into the pharynx should be avoided because their presence results in irritation, which frequently gives rise to the most distressing symptom seen under pentothal anesthesia, laryngospasm. When this is encountered, the anesthesia must be temporarily deepened, and oxygen under pressure must be administered intermittently if the spasm persists more than one-half minute.

An assistant holds the tongue forward by keeping traction on the hemostat. Even for other surgical procedures under pentothal sodium anesthesia, a suture should be placed through the tongue to aid in maintaining an open airway. A gauze oral-pharyngeal partition is carefully placed so as to prevent the aspiration of blood and yet not embarrass the respiration. A suction machine for constant use is essential during oral surgery.

In surgical anesthesia, the respirations are shallow and quiet. A depressed head and chin blocks normal respirations. The head and chin must be held up at all times. So quiet and shallow is respiration that it is a good plan to use a respiration indicator made of a square of tissue paper suspended between the nose and chin. (Fig. 11.) This, of course, cannot be used for oral operations. When possible, it is well to administer oxygen by means of a nasopharyngeal tube. The tube is lubricated with petrolatum (Fig. 12), inserted through the nose into the pharynx and held in position by a strip of adhesive tape. The tube is connected with a wash bottle, which, in turn, is connected with a tank of oxygen. This adjunct not only improves muscular relaxation, but also helps prevent the tendency to lowered oxygenation of the blood, a natural result of the shallow depressed respiration present with this anesthetic.

Anesthesia is maintained by the intermittent injection of small amounts of solution, a fraction of 1 cc., when the patient shows some sign of feeling pain. Pain may be indicated by slight movements of the fingers or toes, tightening of the mandible, phonation or increased respiration.

Much of the difficulty that some anesthetists have with this form of anesthesia can be explained by the fact that they are injecting more solution and too frequently without a definite need for it. They do this to prevent the needle from being clogged by clotted blood or be-

cause they are afraid that the surgeon will object if the patient moves or phonates. Hence, they "overdose" the patient, forgetting that the drug has a cumulative effect. To prevent needle clogging, the Thomas double syringe outfit (Fig. 13) is used, in which one syringe is connected with a reservoir of physiologic sodium chloride solution, which can be injected through the needle as often as desired. The surgeon will readily cooperate when it is explained that the greater the amount of anesthetic, the deeper the respiratory depression, the longer the recovery period and the greater the danger of atelectasis. Furthermore, within a matter of seconds, the anesthesia plane can be deepened.

The needle, of course, remains in the vein throughout the operation. It must be remembered that, the drug being administered intermittently, there may suddenly be a cumulative effect. Hence, it is highly important to pause between injections and observe the effects of that dose before making an additional injection. As the operation progresses, increasingly smaller additional amounts of solution are needed to maintain a satisfactory surgical plane. The intravenous set that I personally prefer is shown in the illustrations, consisting of two syringes connected with one needle by a manifold. (Fig. 13.) By means of small two-way valves, the Luer-Lok syringe can be filled independently of the two reservoirs and injected intravenously independently. Thus, in the one reservoir, we can have 2.5 pentothal sodium solution and, in the other, we can have a physiologic solution of sodium chloride. Or we can place analeptics, cardiac and respiratory stimulants such as coramine, in the saline solution and inject it immediately. Some operators who start with a 4 per cent solution, dilute this to a 2 per cent as the operation proceeds. For prolonged operations, 50 per cent nitrous oxide and 50 per cent oxygen can be used. This method supplies adequate oxygen and reduces the amount of pentothal sodium needed to maintain anesthesia.

Consciousness usually is regained in from ten to fifteen minutes after the administration of an average dose of pentothal sodium. Patient response can be elicited, but analgesia is present for several hours, as desired. This obviates postoperative medication for several hours. Nausea and vomiting or headaches are rarely seen. If respiratory failure occurs, artificial resuscitation is necessary until the effects of the drug have worn off. Use of a resuscitator is effective.

A cardiac and respiratory stimulant such as coramine should also be injected intravenously. The patient should never be cyanotic. Some untoward effects of pentothal sodium anesthesia are acute laryngeal spasm, which may occur if mucus or blood enters the larynx. Tremors, sneezing or violent coughing may take place.

During the operation, there may be signs of circulatory deficiency and shock. The skin is pale, cold and wet and immediate treatment is needed.

Treatment.—The treatment is as follows:

1. The cause, if still active, is removed.
2. An oxygen-rich atmosphere, up to 100 per cent, is provided, with artificial aid to respiratory exchange if indicated.
3. A free airway is insured.
4. The head is placed slightly lower than the heart.
5. Fluids are injected intravenously.[9]

A very satisfactory method of injection employs the apparatus shown in Figure 14. One side of the manifold is connected with one syringe and the other is connected with the phleboclysis set. (Fig. 15.) Intravenous injection of the solution tends to encourage retention of the solution in the blood stream, thereby temporarily increasing the blood volume, par-

ticularly if less than normal, as when wounds have resulted in marked hemorrhage.

CONCLUSION

The dentist trained in anesthesia has a perfect legal, ethical and moral right to administer any and all types of anesthesia for all surgical and obstetric procedures. The subject of general anesthesia has been neglected to a great extent in the majority of dental schools in this country. Now there is a pressing need for trained men in this field, and it is imperative that dental schools not now having an adequate course in this subject immediately institute such a course.

It is to the credit of the dental profession that one of mankind's greatest blessings, surgical anesthesia, was given to the world by two dentists, Horace Wells and William T. G. Morton.

BIBLIOGRAPHY

1. METCALFE, R. F.: War! Anesthesia and Analgesia in Combat Zone. *Cur. Res. Anes. & Anal.*, 20:145, May-June, 1941.

2. PHILIPS, R. B.: Wartime Anesthesia. *War Med.*, 1:781, November 1941.

3. PENDER, JOAN W., and LUNDY, J. S.: Anesthesia in War Surgery. *War Med.*, 2:193, March 1942.

4. KAYE, GEOFFREY: Impressions of Anesthesia in Military Base Hospital. *War Med.*, 3:247, May 1942.

5. DONAGHY, G. E.: Modern Anesthesia for War Surgery. *Mil. Surgeon*, 86:577, June 1940.

6. CRANE, R. M., and SANKEY, B. B.: Recent Developments in Anesthesia of Significance to Military Surgeon. *Cur. Res. Anes. & Anal.*, 20:151, May-June 1941.

7. THOMAS, G. J.: Report on 10,000 Pentothal Sodium Anesthetics. *Pennsylvania M. J.*, 45:467, February 1942.

8. *Idem:* Personal communication to author, April 1943.

9. National Research Council, Subcommittee on Anesthesia; Fundamentals of Anesthesia, an Outline. Chicago: American Medical Association Press, 1942.

Professional Building.

A PREJUDICE TO BE SHED: THOUGHTS ON THE THEORY OF TOOTH FORM AND FACE FORM

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FREDERICK the Great once said that "the greatest and noblest pleasure that we can have in this world is to discover new truths; and the next is to shake off old prejudices." We have discovered many truths in dentistry, and we have also acquired our share of prejudices. Some of them we have wisely shaken off, but some stick.

It has been said that all theories have a life history: they are born, they live and, fortunately, the vast majority die young. It is too bad that some live on for generations to block the path of progress.

One of the most preposterous of our prejudices is the theory of tooth form and face form, a theory which claims that the shape of the face determines the shape of artificial teeth. Thus, a patient with a square face should be given square teeth; an oval face requires ovoid teeth, and a tapering face calls for tapering teeth.

The whole theory is sheer speculation and thoroughly unscientific, and it will not bear analysis. Those who preach the theory seem never to have questioned its validity. Since the theory is based on observations and discoveries unscientifi-

cally interpreted, we can only conclude that the originator had a preconceived idea of what he wanted and then built elaborate props around it to hold it up.

Now, it is not necessary for me to say that I am right in rejecting the theory, and that J. Leon Williams, its originator, was wrong in promulgating it. Dr. Williams' own words belie the validity of his theory. "Nature evidently desires that the outline form of the face and of the upper centrals shall be similar. She achieves this result in a comparatively small percentage of people." He came to that conclusion after examining thousands of human skulls and noting the shape of the skulls and the shape of the teeth. Other observers have found that a similarity between the face and the teeth exists in the minority of people, never in the majority.

How, then, can Dr. Williams, or any one else, predict what nature plans for the majority of people when only the minority respond to his theory? Is there any logic to that? We might just as well say that because in Texas an ass was born with five legs instead of the usual number, it is Nature's magnificent plan to create all asses with five legs. The supporters of Dr. Williams' theory argue like boys, not like scientists.

The man of science always bases his conclusions upon a majority group, never upon a minority. He subjects rats or guinea-pigs to certain tests and experiments, and carefully notes how the majority react. Upon the reactions of majority group he bases his conclusions.

Applying the same method of reasoning to face form and tooth form, we should, if we wish to be logical and scientifically accurate, declare that since, in the majority of people, there is a dissimilarity between the shape of the face and of the teeth, we should select teeth the shape of which differs from the shape of the face. That this is a plan which we might not be entirely unwise in adopting seems to be indicated by the fact that it agrees with the fundamental principles of art, where contrast in form rather than uniformity appears to predominate.

Let us not forget that the human face seldom runs true to type. Rarely do we find a true tapering, a true square or a true oval face. Rather, we find an intermingling of shapes. A child may inherit a so-called square face from the father, and tapering teeth from the mother, and, when he grows up, and perhaps becomes a dentist, he may reveal that he has inherited illogical reasoning powers from both parents.

Another point which we must not forget is that the human face is apt to change considerably throughout life. We see many people with tapering faces, which later in life become round as pumpkins, and vice versa. Therefore, even if the theory of tooth form and face form were correct, and we were to apply it to the letter, we would be obliged to choose one shape of tooth at one time of life and an entirely different shape when the fleshy parts had undergone a change.

But, say the theorists, you are distorting facts. We base the shape of the face upon the bony framework, and that remains constant through life. If the skull is tapering, we know that tapering teeth will best suit the individual. If it is square, we choose square teeth, and if it is oval, we use ovoid teeth.

Possibly there are rare individuals with x-ray vision who can look through and beyond the fleshy parts and see the exact shape of the skull. But most of us have normal vision and therefore prefer to select teeth that harmonize with the visible, rather than with the invisible parts of the head. I have an acquaintance who today weighs 215 pounds. His face is as round as a ball. He has almost perfect teeth, and they harmonize beautifully with his face. When I became acquainted with this

man, twenty years ago, he was tall, slender and angular, with cheeks so sunken that any dentist would have pronounced his face tapering. He had the same teeth then that he has now, and they looked just as well in his tapering face as they do today in his round face. What can the theory of tooth form and face form say about that? Nothing!

The shape of the teeth is much less important than their size, color and placement. A tooth that is nicely shaped and that has a harmonious color and size will look well in any mouth, regardless of whether the face is square, tapering or oval, or the tooth is ovoid, tapering or square. Placement unquestionably comes first in importance. The finest teeth made, if inharmoniously placed, will spoil any face, regardless of whether they are square, tapering or ovoid. When I make that statement, I of course do not mean to imply that any tooth will look well if correctly placed. There are teeth in a variety of shapes, sizes, hues and makes all of which look well when correctly set up. I once knew an old lady whose artificial teeth were entirely too small and too glaring white, but they were so artistically placed that they looked remarkably well.

It is my conviction that the selection of teeth has nothing to do with anything quite so mechanical as measuring the face with a glorified carpenter's square, or squinting at it with binoculars, then guessing at its shape, and selecting teeth to fit the guess. And when I say guess, I mean that without reservation. I have seen more than one so-called expert try to determine the shape of the face with his elaborate gadgets. I recall one dentist, sent out by a tooth manufacturer, who gave a truly remarkable course in denture prosthesis. When he was ready to select teeth, he measured the face with his carpenter's square, and all of us in the class (three of us teachers of prosthetic dentistry) agreed that the gadget said tapering. The lecturer pronounced the face oval, and in spite of all indications, ovoid teeth were used. So today that patient walks the streets of Minneapolis with teeth which, according to the theory of tooth form and face form, would look better behind the face of Tojo than in the mouth of a citizen of the U. S. A.

I had a somewhat similar experience when a member of the faculty of the University of Minnesota School of Dentistry. One of the faculty men had taken a course in denture prosthesis, which he offered to pass on to the rest of us. When he was ready to select teeth for the patient, he sprang a surprise on us. He informed us that he had already made his selection, but asked each one of us to jot down on a piece of paper what his choice would be. It was of course to be expected that not all would agree on the size and hue of the teeth, but if the theory of tooth form and face form were anything to go by, we certainly should all have agreed on the shape of the face. Well, some of us pronounced the face tapering, some square, some ovoid. I was the only one who refused to hand in my slip, because I felt that as long as Dr. Williams, in an unguarded moment, had confessed that the rule of tooth form and face form applied only to a small percentage of people, there was no reason why I should be guilty of helping to install in a patient's mouth something which perhaps would suit the man across the street better than it would suit the patient in the chair.

The selection of teeth is a matter of innate feeling; but it will be found that the act of selection has been preceded by study of teeth and unconscious absorption of what constitutes harmony in each individual case. This study begins while we are still students. It ripens little by little as we progress in our studies, and reaches full fruition after years of practice and observation. At

first, as tyros in the profession, we have a feeling of uncertainty when we attempt to select teeth; of fumbling around, as it were, and it is at this stage of our development that the mechanical selection of teeth makes its appeal to some. They feel that here is something definite. As a matter of fact, there is nothing definite about it: it merely deceives and lulls them into believing that their choice of teeth is correct, even though it may be all wrong.

The moment that we begin to select teeth for a patient, that moment we leave the mere mechanics of dentistry and enter the realm of art, and art is an intangible something which obeys no definite rules. The teacher of art knows that he is dealing with something too subtle for rules; therefore, he never says to a student, "You *must* do so and so because the rule says so." No. He says, "I *feel* that you should do so and so." It is always that innate feeling which is the guiding light.

Some dentists have told me that they have no artistic ability and therefore must rely upon the mechanical theory of tooth form and face form to guide them in their work. It seems to me that any dentist who has enough artistic ability to make a good inlay, a nice gold foil restoration or a natural looking bridge certainly should be able to select the correct teeth for an edentulous patient without resorting to some mechanical procedure. With a total disregard for the theory of tooth form and face form, very good denture practices have been built up, something that would have been impossible were the method of selecting teeth advocated here entirely wrong.

That the theory of tooth form and face form is actually being taught in some of our dental colleges has both puzzled and amazed me.

A representative of the Trubyte company wrote to me recently: "Since Dr. Williams' death, his studies have been carried on continuously and the evidence of what he tried to do is so overwhelming, that I do not think it can be successfully questioned." Whatever evidence has been found is merely more props to hold up a flimsy structure, and must go contrary to the findings of Dr. Williams, who, as has already been pointed out, admitted that in only a small percentage of people is there a similarity between the shape of the face and that of the teeth.

The only way in which a similarity between face form and tooth form could become dominant, since it is not so now, would be by the slow process of evolution. But evolution is never in a hurry. It works as slowly as did the erosion which created the Grand Canyon of the Colorado. If the men who are trying to find new evidence in support of their theory expect to succeed, they will have to wait not a thousand years, not ten thousand years, but upward of half a million years, for that is the rate at which evolution works. By that time, man, if he still exists on this planet, may be an edentulous creature subsisting upon liquids and pap, or he may be a demigod who has discovered how to retain his natural teeth throughout his lengthened span of life, as well as how to grow new ones when some have been lost through accident.

It would therefore be wise for all supporters of the theory of tooth form and face form to rest their case until some remote date in the future. May I suggest the year of our Lord 501,943?

Medical Arts Building.

ODONTOMA WITH THREE IMPACTED PERMANENT MANDIBULAR TEETH: REPORT OF A CASE

MITCHELL MARTIN TANNER,* D.M.D., Boston, Mass.

THE case about to be presented is unique not only from its academic significance, but also because it is one of the few recorded cases in which as many as twenty-eight dental anomalies of toothlike structure have been found in any one patient's mouth, further complicated by the presence of three impacted teeth.

Fig. 1.—Anteroposterior view, showing position of involved teeth.

Fig. 2.—Right lateral view, showing crowns of impacted cuspid and bicuspid, as well as one of toothlike buds mesially from the erupted second bicuspid, which shows absorption at its apical two-thirds. The position of the unerupted third molar is to be noted.

REPORT OF CASE

History.—P. S., a robust colored boy, aged 19 years, first seen by me March 14, 1943, in my office at Camp Bradford, Norfolk, Va., complained of an intermittent, gnawing type of radiating pain, originating in the lower right cuspid area of the mandible, passing distally along the body of the mandible to the temporomandibular joint and continuing to the right temporal and frontal regions of the skull.

Examination.—Oral examination was pathologically negative. The lower right lateral incisor was missing as the result of a previous extraction necessitated by advanced decay while in civilian life. The lower right permanent cuspid and first bicuspid were also absent and in their places were a de-

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ciduous cuspid and a first deciduous molar. All third molars were unerupted. The gingivae were normal in appearance.

The patient was referred to the main dispensary for x-ray pictures of the lower right incisor, cuspid and bicuspid areas to determine the character and condition of the underlying alveolar bone. The x-rays revealed a conglomeration of distorted fragmentations resembling toothlike structures, and the crowns and the coronal halves of the roots of a deeply impacted permanent lateral incisor and cuspid tooth.

Course.—Unfortunately, on the following day, our battalion left Virginia, and the patient was not seen again by me until our arrival at our embarkation point.

About three weeks after our arrival at our present station, the patient again came to my

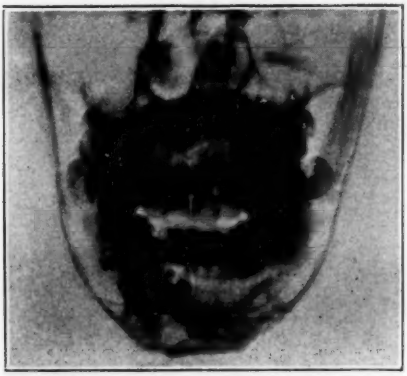

Fig. 3.—Left lateral view, which is negative except for impacted lower third molar.

office, complaining of the same type of pain, only this time the gnawing sensation had somewhat increased in intensity and was of greater frequency.

Examination.—Anteroposterior, lateral jaw and occlusal pictures were taken, the films revealing the presence of three, instead of two, deeply impacted permanent teeth, the third being a permanent first bicuspid tooth.

The positions of the involved teeth were interesting. The bicuspid lay in a somewhat perpendicular position with its crown and root in a buccolingual relation directly beneath the lower right second bicuspid tooth, which showed absorption at its apical third. The impacted cuspid lay almost parallel to the inferior cortical line of the mandible with its crown slightly above the mental foramen, and was displaced in a buccolingual relation. The third impacted tooth, a permanent lower right lateral incisor, was almost vertical to the anterior

Fig. 4.—Occlusal view, showing position of impacted lower right lateral incisor with odontoma. Removal of the tumor was difficult since each budlike tooth was separated from the others in the alveolar process.

Fig. 5.—Occlusal view, showing position of lower right deciduous teeth in line of tumor.

teeth, with its crown slightly distally from the lower third apex of the lower right central incisor, being displaced with its crown in a labiolingual relationship. The entire tooth was rotated with its lingual sur-

face in a distal position. Directly distally from the lower right central incisor and extending to the mesial surface of the lower right second bicuspid tooth appeared this disordered conglomeration of an indistinct mass of what resembled misshaped teeth, individually separated in bone.

Fig. 6.—Deciduous cuspid and first molar removed to facilitate surgical measures. In their relative position are shown the three impacted permanent teeth and the conglomeration of misshapen teeth that comprised the odontoma. The bicuspid was broken during manipulation.

Surgical Procedure.—Lower right and left mandibular block anesthesia was used, coupled with right and left labial and right buccal infiltration. A 1-inch vertical incision was made at the interdental papillae between the lower central incisors and the mucoperiosteum was dissected back to the lower right first molar.

After Care.—After the removal of the involved teeth and the odontoma, 60 grains of sulfathiazole was disseminated throughout the area operated upon and five interrupted sutures were used to close the buccal and labial tissues.

Comment.—There is a possibility that the lower right impacted third molar may eventually be contributory to the slight pain still experienced at the right temporomandibular joint, although the operation itself may have contributed to the prolongation of the pain. Again, a right chronic mastoiditis, with which the patient had suffered for the past few years, may be a notable contributory factor.

Outcome.—One week after the operation, the patient reported some tenderness at the temporomandibular joint, but cessation of pain in the cuspid and bicuspid areas, as well as in the temporal and frontal regions.

Fig. 7.—Odontoma. The similarity of some of these teeth to the deciduous and developmental dentition is evident.

There is no swelling in the area operated upon and healing is proceeding very satisfactorily.

THE LENS GRINDER OF DELFT

LEEUWENHOEK'S DENTAL PROBINGS

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IN the seventeeth century, the lens was focused on life. Inquisitive minds and eager eyes enjoyed their first rapturous look at the doings and structures of the smaller bits of living matter. Wonders of nature were unfolded. Nothing was too insignificant, nothing too ordinary, to be subjected to microscopic examination. A sharp light was thrown on everything. A hitherto invisible world swarmed into sight. Life began to have a new meaning.

The stimulus for this uncommon activity in the study of nature was given by Antonj van Leeuwenhoek, the self-trained expert lens grinder of Delft, Holland. Like his neighbors, who were mystified by his doings, he was gossipy, stubborn and proud of his Dutch, the only language he knew.

Leeuwenhoek was the first human being to see the world of bacteria, a world destined to rival in popular interest that of the atom and the outer infinity revealed by the telescope—the cosmos. He pointed the way that, a century and a half later, led Louis Pasteur, through his studies of the diseases of wine and beer, to lay the foundations of present-day bacteriology.

About fifteen years ago, Paul de Kruif[11] centered interest on Leeuwenhoek in a stimulating account of his bacteriologic achievements. Here was the first of the microbe hunters, a student of a bit of almost everything under the sun. Uneducated and ignorant of formal science, Leeuwenhoek was the "consummate amateur,"[16] who had a gloriously good time peeping at everything about him through a lens. His bright mind, his unbounded curiosity moved him to reveal many secrets of Nature. He discovered the human spermatozoon, the generation of fleas and the true nature of capillary circulation, a finding that completed Harvey's theory.

Because so little is ordinarily said about Leeuwenhoek's dental probings, one is amazed at the precocity and scientific detail of his dental investigations. One day, this tireless investigator would study the anatomy of teeth; another, he would scrape the teeth of friends in search of "animalcules." Leeuwenhoek examined with his lenses the teeth of elephants, hogs and human beings. He was the first to study the histology of teeth.

To Leeuwenhoek is credited the first known description of the dentinal tubuli.[5] "Using grinders [molars] and applying better glasses . . . we plainly saw," he wrote to the Royal Society of London in 1678, "that the whole tooth was made up of very small, straight and transparent pipes; six or seven hundred of these pipes put together, I judge, exceed not the thickness of a hair of a man's head."[14]

He observed, too, that the "little boney pipes," as he called the dentinal tubuli, are "closely joined together," and arise "at the cavity [the pulp chamber or canal] in the middle of the tooth and end at the circumference or outside."

Leeuwenhoek also noted that the tubuli lying near the outside of the tooth were extremely hard. He considered them [which we know as the enamel rods] to

be the "solid core, shell, or covering of the tooth."

About Leeuwenhoek's personal life only meager details are available.[8] He was born October 24, 1632, married and became the father of five children, only one of whom, Maria, survived. Maria never left him. She was his housekeeper, devoting her life to the care of her father and his numerous "microscopes." (Leeuwenhoek used magnifying lenses. His instruments, as described later in the paper, are in no way comparable to the compound microscope used today.) While apparently he never perfected himself at linen draping or surveying or at being chamberlain to the sheriff of Delft, jobs he held at various periods, he did become expert in the art of grinding and polishing lenses and in the use to which he put his magnifying glasses.

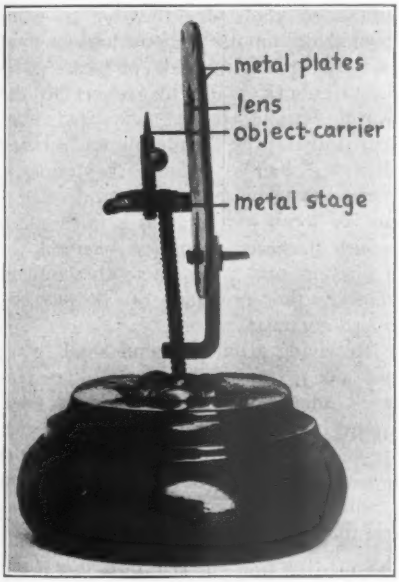

Fig. 1.—Side view of model of Leeuwenhoek's "microscope." (Courtesy Army Medical Museum, Washington, D. C.)

Fig. 2.—Front view of model shown in Figure 1.

Fame came to Leeuwenhoek April 28, 1673, when his work was brought to the attention of the Royal Society of London by a fellow townsman, Regner de Graaf, a noted Delft physician and anatomist. Four months later, August 15, 1673, marked the beginning of Leeuwenhoek's oft-quoted correspondence with the Society, which was to last for almost fifty years.

Leeuwenhoek's letters were his scientific papers; but more than his observations are recorded. A "strange sense of intimacy" runs through most of them. In spots, they read like paragraphs from some of the well-known New England journals that have enriched American thought and literature. Many of his deepest promptings, his philosophy, his habits and his ailments are revealed in them. They shed light, too, on his method of work, his sincerity, his honesty and his unassuming manner.

The discipline of a scientific mind is evident in most of the letters. Leeuwenhoek was imbued with the experiment-

er's objectivity. He was careful to differentiate between fact and speculation. Again and again, one reads "I have observed" or "I then saw," when facts are reported. But when resorting to interpretation, he invariably introduced his thoughts by such phrases as "I imagine" or "I figure to myself." You might fancy him telling a researcher who disagreed with one of his observations: "You may be right. I'll check your findings with my newest magnifying glass." Writing to the Royal Society, he said: " . . . 'tis my habit to hold fast to my notions only until I'm better informed or till my observations make me go over to others; and I'll never be ashamed thus to chop and change."[4]

To one attitude, however, Leeuwenhoek held fast. Unlike many of his contemporaries in science, he guarded jealously his art and knowledge. He wanted neither the anxieties nor the satisfactions of the teacher, so he never had a pupil. He regarded teaching as drudgery. To Leibnitz, the philosopher, he wrote that he never taught any one because "if I taught one, I'd have to teach others . . . I would give myself over to slavery, whereas I want to stay a free man."[12]

Leeuwenhoek believed in oral hygiene. At the age of 50, he boasted of his good dentition and the excellent condition of his gums. Interest in the "white matter" between and on the teeth led him to a significant discovery. His letter describing it is of great import to dentistry.

'Tis my wont of a morning to rub my teeth with salt and then swill my mouth out with water; and often, after eating, to clean my back teeth with a toothpick, as well as rubbing them hard with a cloth; wherefore, my teeth back and front, remain as clean and white as falleth to the lot of few men of my years; and my gums, no matter how hard the salt be that I rub them with, never start bleeding. Yet notwithstanding, my teeth are not so cleaned thereby, but what there sticketh or groweth between some of my front ones and my grinders, whenever I inspect them with a magnifying mirror, a little white matter, which is as thick as if it were batter. On examining this, I judged that there yet were living animalcules therein . . . on mixing it with clean rain water or with spittle, I then most always saw, with great wond'er, that in the said matter there were many very little living animalcules, very prettily amoving.[5]

Leeuwenhoek's description of how he guarded the "gateway to health" and his findings were the forerunners of the wealth of knowledge that we have inherited on mouth hygiene and on oral bacteriology. Hundreds of years after Leeuwenhoek made his report to the Royal Society, dental scientists[9] were still studying the "white matter." Using delicate, highly refined bacteriologic measuring devices, they found that 1 mg. of tooth scrapings in a fairly clean mouth harbored 5,000,000 bacteria. In a dirty mouth, 1 mg. of tooth scrapings showed the presence of 800,000,000 micro-organisms.

Receiving from a friend small maggots taken from carious teeth, Leeuwenhoek identified them with the kind found in certain cheeses commonly eaten by his fellow citizens. He thought the worms which had been lodged in tooth cavities were responsible for the odontalgia that ensued. He wrote:

I received from Sir Hans Sloane a packet containing three small maggots, two of which were dead and a third alive, with a letter informing me that they were found in a person's decayed teeth from whence they had been expelled by fumigation. Upon examining these I had no doubt that they were of the sort found in cheese, and upon comparing them with some living ones which I procured from a cheesemonger, I found them to correspond exactly in make and shape.

These maggots are the offspring of a small fly frequently found in cheesemongers' shops which lays its eggs in the cheese where the little maggots produced from them find

nourishment and are in time converted into flies.

The maggots sent me by the cheesemonger I kept in a glass tube and supplied them with food and in a short time they were converted into flies which laid eggs and these again produced maggots of the same kind as the former.

The living maggot which I received from Sir Sloane I kept by itself and it was also converted into a fly of the same species. . . . Now it is easy to conceive that the person in whose tooth the maggots were found might have been eating of such old cheese and that the maggots or the eggs producing them have been lodged uninjured in the cavity of the tooth where when they began to gnaw they must cause great pain.[15]

This conclusion would seem to indicate that Leeuwenhoek did not agree with the tenets of the now disproved maggot theory of tooth decay. It is significant that he did not say that the worms caused the tooth to become carious.

Incidentally, the observation that maggots are the offspring of small adult flies may be cited as evidence of Leeuwenhoek's opposition to the theory of spontaneous generation popular in his day. It was believed, even by some of the best minds of the seventeenth and eighteenth centuries and later, that an omnipotent power created new beings with no similar predecessors and that "highly organized animals may spring from sources unrelated to the natural processes of physiologic procreation."[17] That mice, for example, could be generated under suitable conditions from corn, grains and rags was a commonly accepted notion.

For not keeping in line with these ideas, Leeuwenhoek was severely criticized. There was no time to enter into heated controversies. There was too much work to be done. There were too many visitors—kings, scientists and others. (Even Peter the Great of Russia, when in Holland in 1698, took time out from studies of ship-building methods, anatomy and engraving to visit Leeuwenhoek.) The critics went unheeded. One day, however, the Delft *voyageur* in science answered the partisans of the theory of spontaneous generation. And the reasoning in his reply is as true today as when it was first written: " . . . it does not seem strange to me that there are still some who do not accept my proposition regarding generation; for novelties oft-times aren't accepted because men are apt to hold fast to what their teachers have impressed on them."[6]

Leeuwenhoek's conclusions regarding the cause of tooth decay were not so advanced as his attack on spontaneous generation. Dental caries, he wrote, was due to an obstruction of the "boney tubuli" brought about by the distention of the blood vessels in the dental pulp. This implies that tooth decay appears to be dependent on a nutritive or inflammatory disturbance, a belief that formed the basis of the "humoral hypothesis," which attributed all forms of diseases to disorders of the blood and lymph circulation.[2] The decaying process would thus be considered an internal one, beginning in the interior of the tooth and proceeding outward.

Modern dental research does not seem to have abandoned entirely Leeuwenhoek's original conception. In fact, C. F. Bodecker[1] believes that while the exciting cause of caries is exterior and local, predisposing etiologic forces originate in the interior of the tooth. Teeth may be affected from the interior by the condition of the blood and lymph, says Dr. Bodecker, since these elements influence the nutrition of the dentition. But here any similarity of the work of Bodecker to Leeuwenhoek's idea ends.

The existence of a system of channels joining the enamel with the vascular system of the body is the basis of Bodecker's hypothesis. Through these channels is transmitted the nutritive fluid of the teeth. This "dental lymph," as he terms the fluid, originates in the blood of the

dental pulp and is secreted by the odontoblasts. It contains mineral salts and possibly fats. These essential substances it conveys through the dentinal tubules to the enamel tufts, enamel rod sheaths and lamellae, whence it is distributed by diffusion to the surface of the tooth.

Bodecker's conception of the nutrition of the dental tissues and its relationship to dental caries brings to the fore a controversial question far from the scope of this paper.

That Leeuwenhoek saw so much and so well is a tribute to his keen powers of observation. His discoveries were not made with microscopes. He did not have the beautiful, calibrated instrument used by the researcher today. Only finely perfected magnifying lenses were his tool.

Essentially, his "seeing-eye" consisted of two thin oblong metal plates with a small biconvex lens mounted between them. The object was held in front of the lens "on the point of a short rod," the object-carrier, "the other end of which was screwed into a small block or stage of brass."[7]

In the modern compound microscope, the lens is focused on an object lying on a fixed stage. Leeuwenhoek constructed his instruments, however, so that the object, which was movable, was brought into the focus of the fixed lens. The object was stuck directly on the pin of the object-carrier or mounted first between two thin glass plates like a modern slide and cover glass. After the object was set, it was focused before the lens. Because Leeuwenhoek's "microscopes" were of very short focus and high magnification, it was often necessary to place the eye in contact with the lens to see the object clearly.

When he died at the age of 91 (August 26, 1723), Leeuwenhoek left 247 "microscopes," each with a lens and generally also with an object.[8] Figure 1 shows a model of one of these microscopes now in the Army Medical Museum at Washington, D. C.

In recent years, almost every schoolboy has learned of Leeuwenhoek, the microbe hunter. But we should remember him particularly for his discovery of capillary circulation and the dentinal tubuli, and for bacteriologic studies, including study of the micro-organisms he found in the "white matter" scraped from teeth. We should respect the clear thinking that enabled him to distinguish between observation and theory. We should know too that he delivered telling blows to the myth of spontaneous generation.

BIBLIOGRAPHY

1. BODECKER, C. F.: Nutrition of Dental Tissues. *Am. J. Dis. Child.*, 43:416, February 1932.

2. BUNTING, R. W.: Textbook of Oral Pathology. Philadelphia: Lea & Febiger, 1929, p. 166.

3. DOBELL, CLIFFORD: Antony van Leeuwenhoek and His "Little Animals." London: John Bale Sons and Danielsson, Ltd., 1932.

4. Reference 3, p. 73. (Letter 74, August 12, 1692.)

5. Reference 3, p. 237. (Letter 39, September 17, 1683.)

6. Reference 3, p. 75.

7. Reference 3, p. 328.

8. Reference 3, p. 321.

9. GIES and KLEIGER, quoted by T. P. Hyatt in "Grade 'A' Mouths for Grade 'A' Milk," Radio Manual, Oral Hygiene Committee, Greater New York, 1939, p. 90.

10. GUERINI, VINCENZO: History of Dentistry. Philadelphia: Lea & Febiger, 1922, p. 247.

11. DE KRUIF, PAUL: Microbe Hunters. New York: Harcourt, Brace & Company, Inc., 1926, Chap. I.

12. Reference 11, p. 23.

13. VAN LEEUWENHOEK, ANTONJ: Selected Works. Trans. by Samuel Hoole, London, 1800.

14. Reference 13, Vol. I, p. 113.

15. Reference 13, Vol. I, p. 119.

16. PEATTIE, D. C.: Green Laurels. New York: Simon & Schuster, 1936, Chaps. I and II.

17. WARBASSE, J. P.: Doctor and Public. New York: Paul B. Hoeber, Inc., 1935, p. 226.

40 Woodruff Avenue.

ECONOMIC SUCCESS IN THE PRACTICE OF DENTISTRY

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WHAT constitutes economic success in the practice of dentistry may vary according to one's own version of his desires. The first prescription to fulfil our desires can be written in four little words: Do not hurt people.

The surveys that have been made in the various states as to why people do not avail themselves of dental care or why they wait so long before seeing a dentist give us the following information:

1. From 45 to 55 per cent do not avail themselves of dental care because of fear of pain.

2. From 25 to 35 per cent are neglectful because of anticipated expense.

3. Only from 10 to 20 per cent do not avail themselves of dental health through procrastination.

Therefore, it should be obvious that to get the maximum results with the least amount of effort, we must give more consideration to the control of pain.

Our second prescription for economic success should be to control the expense to the patient. The old proverb "an ounce of prevention is worth a pound of cure" is a good rule to follow.

To reduce expenses, protective dentistry must be practiced, and it cannot be practiced when destruction has gone so far that artificial substitutes for the natural teeth must be employed. We must be capable of performing all operative procedures satisfactorily to every one concerned so that protection can be practiced throughout the entire life of an individual. Regular and frequent visits to the dentist beginning in early childhood are less painful to both mind and pocketbook.

Since procrastination is the result of many conditions, our third prescription for economic success includes both the first and the second prescription, plus public education. All lay education programs supplementing the educational programs in our offices will demonstrate that procrastination is not only expensive but also destructive.

FIRST PRESCRIPTION: CONTROL OF PAIN

There are two possibilities regarding pain: First, there may be actual or real pain. Secondly, pain may be mental, or imaginary. It is possible, by the employment of known therapeutic agents, to control all actual or real pain. Therefore, we should acquaint ourselves with and prescribe and employ these agents routinely when and where they may be needed.

Sedatives.—Frequently, the nervous or highly excitable patient should be given some sedative before his first few visits to the dentist, or at least until an understanding and normal relationship has been established. I find that pentobarbital sodium USP, three-fourths to 1½ grains, is very effective as a sedative. The dosage varies according to the weight of the patient.

Topical Anesthesia.—The use of tinc-

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Read at the annual meeting of the California State Dental Association, April 1943.

ture of iodine, the tensing of tissues and the application of butyn or ethyl aminobenzoate to the mucous membrane lessens the sensation from insertion of the hypodermic needle. We should use as much finesse as possible, such as slow deposition of the solution injected, to make things pleasant and comfortable for our patients.

Local Anesthetics.—There should be no hesitancy in the use of local anesthetics regardless of the age of the patient, yet most of us are influenced by the fact that we harbor, perhaps unknown to ourselves, certain fears regarding the use of local anesthetics and the equipment necessary to their administration.

Some of these fears are: (1) that we may break the needle; (2) that we may do the patient serious injury by the use of a hypodermic needle; (3) that we may not attain complete anesthesia and may have to repeat the procedure, and (4) that the anesthetic solution will have some deleterious effect upon the patient.

Take our first fear, for example, the fear that the needle will break: How frequently do we hear of or see reported the breaking of a needle? The chances are less than one in a million that this can happen to us as long as we are careful, use proper equipment and have our patient under control. Let's not make a mountain out of a mole hill.

Second is the fear that we may cause the patient serious injury by the use of a hypodermic needle. We shall cause no permanent injury if we are at all acquainted with the anatomy and have developed or studied any one of the many technics of injection. It is true that if the needle punctures a blood vessel, a hematoma may result, but except for its appearance, no damage will be done.

Third is the fear that we may not establish complete anesthesia and may have to repeat the procedure. If we master any one of the accepted technics, we can absolutely depend on anesthesia, and if at first we do not succeed, there is no reason why we should not try again at the same appointment or at a later one.

Fourth is the fear that the anesthetic solution will have some unfavorable effect upon the patient, young or old. This fear can be dismissed if we never inject more than 2 cc. of a solution that contains a vasoconstrictor of 1:50,000, 1:60,000 or 1:75,000 concentration. This amount of solution properly placed will produce anesthesia for any operative procedure.

In the control of actual or real pain by the administration of therapeutic agents, we lessen mental, or imaginary, pain. When we know that all actual pain will be controlled, we feel and show an absolute confidence in all operations to be performed. This confidence cannot be a veneer, but must be genuine, so that it may be unconsciously transmitted to the patient.

In the first interview with a prospective patient, we must lend a sympathetic ear to all detailed descriptions and show a decided interest in order to create a favorable impression. We must always be sympathetic with parents if they are discussing the dental problems of the child, since they sincerely believe that an ordeal is about to be undergone by the child. This may be an old story to us, but it is a new story to them. It is not only bad form, but also bad "public relations" to treat their dental troubles lightly. This is our chance to establish confidence, and if we do not listen to what parents have to say, how can we know what their problems are?

Frequently, the discussion concerns the child and the parent usually makes such a statement as "Mary is such a frail nervous child. I don't suppose much can be done for her."

Did you ever stop to think that when you ask a child to walk from the northeast corner to the southwest corner of a

room, the child knows that he may walk on a straight line from one corner to the other or that he may also walk from the northeast corner to the northwest corner and then to the southwest corner or from the northeast corner to the southeast corner and then to the southwest corner of that room? There are also other possibilities of getting from one corner of the room to another corner of the room. This gives the child a choice of route in going from one point to another. Whenever a patient is given more than one choice, we set up a state of confusion in his mind. With a state of confusion, there are always nervous reactions, whether in a child or in an adult. We are better off in all our professional relationships if we do not give the patient a choice, but give him a direct command. Let us always, particularly with the child, command agreeably, firmly, but definitely, so that there can be no choice whatsoever.

We must establish the adult's confidence in us as to our ability to render professional service. The parent is assured that, in five, ten or twenty years in the practice of dentistry, we have yet to find the child or adult for whom we cannot, and without any difficulty, do anything that needs to be done. The parent is assured that many similar cases have been treated with complete success and that the most nervous patients always become our very best patients. Such statements must be true.

I can honestly say that, in twenty-three years of practice, I have yet to find the child that I cannot do anything for at any time that I desire to do it. An adult's hallucination or mental suffering is transmitted to the child, but when we sow seeds of confidence that the child can and will be cared for by people who know how to care for him, this confidence will be transmitted to the child. The child and adult patient will be entirely different reacting individuals as to our wishes and desires.

Our offices should present a proper environment, a reception room with a few objects of interest to the child and adult patients. A gold fish bowl, a growing plant, books and magazines suitable for children will make the young patient feel at home and at ease. Do you know that there are more doormats sold in the United States with the word welcome on them than any other kind of doormat? We should not need a doormat with the word welcome on it, for our reception room should reflect the impression that all patients of all ages are welcome at all times. Even a janitor is human, and it does no harm to smile and say "Good morning" even if it is raining.

Our operating room should give an impression of serious consideration of the problem to be dealt with and not one of frivolity and play. Our business offices should have a business-like atmosphere.

The dentist should welcome the patient into the operating room by calling him by name and quietly and affably asking him to seat himself in the operating chair. He should explain as nearly as possible, to the adult patient or the parent of the child, the conditions present and the treatment to be instituted, stating the amount of work to be done, the fee, the payment and the most satisfactory time for appointments. Here is a golden opportunity to inform the parent that the work to be done will be lasting and of great benefit to health and appearance, unless one does that kind of work whereby a filling is placed in the afternoon and by evening has fallen out.

My experience in postgraduate teaching has brought me to a realization that the average dentist is not firm enough. By this I mean that when he takes hold of the patient in the operating chair, the dentist does not give the impression that he is in absolute control of everything that he is going to do. One should not take hold of the patient as if he were

some breakable object, nor should he in any way show a tendency to roughness. Firmness, friendliness and truthfulness help materially in establishing confidence in us as professional people.

1. We should never allow ourselves to be disturbed by any situation that might arise.

2. Let us avoid all controversies and remember that we are sought out for our ability as a dentist. One learns that carrying a chip on his shoulder is the easiest way to get into a fight.

3. People are no harder to get along with in one place than in another, and "getting along" depends about 98 per cent on our own behavior.

4. We should never try to fool a child, for he can read us like an open book.

5. We should keep our temper: no one else wants it.

SECOND PRESCRIPTION: CONTROL OF EXPENSE

It should be our duty to control our patients' expenditures whenever possible. Business surveys show that health expenses are practically never allowed for in family budgets, so these expenses are never anticipated.

In order to meet this common problem, many known office procedures can be employed.

Naturally, our first prescription, control of pain, is an important factor in reducing anticipated dental expense, as it will be possible to accomplish more work under these favorable conditions in any given amount of time. Also, all operations can be carried out with greater exactness and precision, from which the patient will benefit by a longer life of all restorations and normal mouth health. These important facts cannot but help, over a period of time, to reduce average yearly dental health expenditures.

To prove the point that "an ounce of prevention is worth a pound of cure," one needs but to recall in his own practice those patients who have adhered to this rule and have made regular and frequent visits to the dental office for routine examination and prophylaxis.

Studies have been reported[1] showing that an average of fifty-five operative hours is sufficient to care for our young patients the first twenty-two years of their lives. The first twelve years of the child's life accounts for twenty hours of time, and the next ten years takes an additional thirty-five hours. This type of practice, one might term "protective dentistry," as it protects not only the teeth, but also the oral cavity, which is the gateway to the human body, through which seven out of ten diseases gain entrance. This also reduces the over-all expense and necessitates an annual budgeting of dental health expense.

A routine recall system should be established in every practice, that protective dentistry may replace reconstruction. In this way, expenses will be minimized and small regular payments fit into the average family budget.

When larger sums must be expended because of neglect or uncontrollable circumstances, the establishment of a plan whereby payments are made directly to the office, to a bank or to a reliable financial concern does assist the patient.

The reduction of unpaid accounts and the verification of the credit habits of new patients by a careful check as to their credit ratings through a commercial retail credit association or financial institutions will decrease overhead expenses. The establishment of business-like methods in an office will prevent loss of money and time, helping to eliminate broken appointments and other bad patient habits. These business-like methods will conserve the time of the dentist and his assistant so that each day will show an increase in production hours.

Postgraduate studies to improve and speed up technics help to reduce patient expense. We learn that most of the

other fellows are as ambitious as we are; that they have brains that are as good or better, and that hard work and not cleverness is the secret of abiding success. Postgraduate instruction in dentistry for children is needed by the average general practitioner. Children's dentistry, as a general rule, yields the least in returns to the dentist and is least appreciated by the parent. This need not be the case if one will give serious intelligent consideration to this second most important phase of success in the practice of dentistry. Brown says[2]:

We have found dentistry for children a profitable, not unpleasant, phase of practice. We treat it as we would any profitable branch of our practice, maintaining a business-like attitude throughout. We present the need to the parent honestly; our fees are based upon a cost-profit hourly basis; the child is treated as an individual; the operative service is conscientiously performed. Adapting such a program to your personality and community will make dentistry for children a profitable practice for the child, parent and you.

THIRD PRESCRIPTION: EDUCATION

As previously stated, procrastination is the result of many conditions and a common fault of all human beings. The best weapon to combat this fault is the lay educational program.

Such programs are sponsored by the state departments of health, school departments and the American Dental Association, which should receive our support and commendation. These programs should be supplemented by our individual office educational program if we are to eliminate the public's apathy to oral health.

The correction of this apathy cannot be handled individually in our own offices, but must be an objective of the entire profession through organized dentistry.

CONCLUSION

To succeed economically in the practice of dentistry, we must first control fear through the elimination of pain, both real and imaginary. Secondly, we must decrease expenditures as nearly as possible or budget these expenditures by a time payment plan or by practicing protective dentistry. Thirdly, we must support all ethical and approved lay educational programs.

BIBLIOGRAPHY

1. SWEET, C. A.: Are Teeth Insurable? J.A.D.A., 27:215, February 1940.

2. BROWN, S. C.: Making Children's Dentistry Pay. *Oral Hyg.*, 32:631, May 1942.

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MAXILLOFACIAL INJURIES PRODUCED BY GUNSHOT WOUNDS IN MODERN WARFARE

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AFTER eighteen months of war, it appears that certain procedures have been sufficiently employed by the Medical and Dental Departments of our military forces to be used for comparative appraisal. Casualties are divided into wounds, fractures and burns. The surgical experience of our own forces was largely acquired after the Pearl Harbor attack. However, abundant literature from British, Russian and French sources is now available. To add to this knowledge, we have the actual experience gained by the dental branch at Barnes General Hospital, while maxillofacial injuries are under care and observation.

The most important feature of basic treatment is the time element, or that period between the onset of injury and definitive treatment. Gunshot wounds are usually classified and treated as infected.

In combat, dental personnel are employed in the same manner as other medical personnel. Emergency treatment and evacuation of wounded become the paramount responsibility. Dental officers act as specialists in the treatment of maxillofacial wounds. They may be assigned to any of the battalion medical sections to augment the commissioned complement, or to act in replacement of medical officers who become incapacitated.

Injuries to the face and jaws vary widely in severity. They may be simple superficial cuts or bruises of the soft tissues or they may involve fractures of the jaw and facial bones with considerable loss of soft tissues. Patients with an injury to the face may be under great mental stress because of a conviction of unsightliness, either fancied or real. Therefore, it cannot be overemphasized that early and adequate treatment of these wounds, regardless of their severity, is of utmost importance, in order to safeguard against serious complications and subsequent deformities.

In the training program, medical and dental officers of the maxillofacial teams pursue the same special course. The spirit of team work and unity is thus developed to the maximum in the Army. The dental officer who is an integral part of such medical units must complete the training routine covering the early care of gunshot wounds, gas poisoning and other battle emergencies. The training makes him a valuable assistant to the medical officer in every aid station, clearing station and hospital; the problems of fixation and stabilization, restoration of occlusion and ultimate dental function being best solved through this collaboration. It is intended to provide an incomparable plastic service, placing the responsibility for surface reconstruction and repair on the plastic surgeon.

We are chiefly concerned at this time with gunshot wounds of the face. With the exception of cuts and abrasions and minor injuries, these wounds differ from civilian injuries in certain respects. First, they are usually associated with fractures of the bones of the face, and the extent of the injury depends not only on the speed and shape of the missile, but also on fragments of bone and teeth which

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act as secondary projectiles, inflicting further damage. As a result, this damage is usually greater at the exit wound than at the entrance wound. Secondly, gunshot wounds of the face associated with bone injury are all potentially or actually infected. There is much tearing of soft tissue and many jagged particles of bone may become embedded in the tissues at some distance from the wound. Thirdly, there may be a loss of tissue. However, the actual destruction or complete tearing away of tissue is rare. Very often, there are large gaping wounds through which may be seen exposed and fractured parts of the mandible or other bones, but, on close examination, it is usually possible to trace the borders of the wound, and frequently there is simply a loss of several teeth or alveolar bone. However, in all facial wounds, whether or not there is an initial loss of tissue, there may eventually be a great loss through infection or localized osteomyelitis.

Another difference between civilian injuries and gunshot wounds of the face and jaw is the involvement of blood vessels and nerves. In civilian injuries, one rarely encounters primary or secondary hemorrhage of a sufficiently troublesome nature to cause the surgeon great concern. In gunshot wounds, the picture is directly reversed. Primary hemorrhage may be severe enough to cause great weakness, and even shock, before the patient is seen by the surgeon. A secondary hemorrhage in these injuries or wounds is the most dreaded complication. With these differences in mind, we are ready to consider the treatment of a casualty, let us say an extensive gunshot wound of the jaw. In these cases, there is usually a large gaping wound, which, on examination, presents a great deal of soft tissue destruction and marked comminution and displacement of bony fragments.

We have found that by the time evacuation has been accomplished, the patient has usually suffered a certain amount of mental shock and is weak from fatigue and toxic absorption from the wounds. A moderate leukocytosis, polymorphonuclear in type, usually develops in these cases. The maxillofacial wounds are usually saturated by masses of pus and are often accompanied by injury of another part of the body. Enucleation of an eye may be necessary. A limb may be injured or feet or hands frozen, the condition necessitating amputation. A bullet may have penetrated the chest or abdomen with all the accompanying complications, such as internal hemorrhage. Occasionally, parts of the skull may be torn away, or there may be large areas of gas gangrene. These various multiple injuries necessitate the close association and cooperation of the other services of the hospital, such as the eye, ear, nose and throat, orthopedics, medicine and surgery. The treatment of such a case may be divided into three stages. The first stage is the care given immediately after the injury. The second stage includes the first few weeks following the injury. In the third stage, further plastic operations and repairs may be carried out.

It is obvious that the immediate treatment after the injury is directed toward saving the life of the patient, who may be exhausted and suffering from exposure and hunger, and may be in shock from loss of blood. The first procedure is to institute measures to stop any active bleeding.

Injuries around the jaws also often interfere with another vital function of the body, namely respiration. It is essential to protect these wounds against further injury. The transportation of a patient with a wound of the face or jaws thus becomes a serious problem. Many patients have been picked up on the battle field and placed on a stretcher or in an ambulance while still alive, but, upon arrival at their destination, are found to have died, owing to failure of

respiration, because of the position in which they were placed. Patients with face and jaw injuries should, when possible, be transported in a sitting position because respiration is thus freer. If they must be taken in an ambulance or on a stretcher in a reclining position, they should not be on their backs, since this position favors the collapse of tissues back into the pharynx, but should be placed face downward or well over to one side. This position will help to keep the air passages free and will allow mucus and blood collecting in the throat to be expelled. It is obviously important, therefore, to see that there is a free respiratory passage. In a wound about the jaw extending from one side to the other, carrying away the anterior portion of the mandible and severing the muscles at the point of insertion, a contracture of these muscles takes place also pulling the chin segment back. The tongue and other structures will also be carried back, obstructing the respiration.

It is vital in such cases to hold the tongue forward and maintain a passage through the throat. One way to do this is to suture a safety pin to the tongue, tying a thread or string to the pin and attaching it to the clothing or dressing, and thus holding the tongue out. Another method that may sometimes be used is to pass a piece of rubber tubing through the nose back to the pharynx or through the mouth to the pharynx to maintain respiration. Certain forms of splints and wires to be attached to the teeth have been devised, whereby wires extending out from the teeth can be attached to the head to hold the anterior portion of the jaw forward. Fixation of the mandible must be accomplished in such a way that the important functions of swallowing and coughing are permitted.

Most hemorrhages around the face, unless very large blood vessels are involved, can be controlled by simple application of sterile dressings and pressure bandages.

Care must be taken not to place too great continued pressure on the vessels, which might cause complications. In other cases, it may be necessary to clamp the bleeding points. If there is bleeding through the nose, an anterior pack or postnasal plug may be used. In rare cases of profuse hemorrhage, it may be necessary to ligate the external carotid artery. If the patient is in shock, treatment to combat this condition must be instituted. The patient is made as comfortable as possible. Pain is allayed by the administration of opiates, and, if indicated, administration of blood plasma is frequently a life-saving measure, and is one of the great contributions of medicine that have been added to our armamentarium.

After the patient is comfortable, shock has been combated and bleeding stopped, an examination is carried out. The thoroughness of this examination depends on the condition and comfort of the patient. A general physical examination is made, and the local wound is examined, the examiner keeping in mind that there may be multiple injuries. In examining the face, the number of lacerations is noted, with the depth of the lacerations and the bones involved. In examining the mouth, we make a note of the loss of teeth and account for the teeth if possible. For example, a missing tooth may have been aspirated. For this reason, if the patient has an elevation of temperature or has any respiratory difficulties, an x-ray film of the chest is indicated for foreign bodies. The entrance and exit wounds are also carefully examined for foreign bodies. The extent of soft tissue loss and damage is also noted. Existing teeth are also examined. Loose teeth embedded in bone should not be hastily extracted. The tooth may be valuable in maintaining the bone fragments in position. Even when it is broken off, devitalization of the exposed pulp may be better than extraction of the tooth. The tooth might also be used in attach-

ing or maintaining a splint, or be valuable in some subsequent treatment.

When accessible, foreign bodies should be removed, but they should be deliberately undisturbed if the search should be prolonged or mutilating. Despite size and location by the x-rays, it is often impossible to find foreign bodies.

Among the Pearl Harbor casualties, the locater, an electromagnetic induction apparatus, was used successfully. It determines surface location and subsurface depth. A probe or finder can be placed in an open wound as an additional aid. This machine, called the Berman Locater, was devised by the Electrical Engineering Department of the New York City Transit System. The first trial of the device was made at the Reconstruction Unit, New York Post Graduate Hospital. It was used successfully as far back as the bombing incident at the New York World's Fair, when fragments were removed from the wounds of some of the police officers. The first mass usage of the device was made in the Army Hospital after the Pearl Harbor attack. The original apparatus was brought to Pearl Harbor by Col. John J. Moorhead, M.D. The original device is still in use in the hospital. Improved models have since been manufactured and are being used in a number of places.

Another recent development in the use of the x-rays was introduced at Columbia University in New York by Dr. Klein, a dentist, and his brother, also a dentist. Their apparatus consists of a scaling device attached to the x-ray film and tube. A mathematical computation gives the surface and depth dimensions to within 1 mm., and by the use of a polarized optical lens viewing glass, the third dimension is obtained. Successful clinical application of this device is reported by Columbia University, and the Army is now in the process of testing this method, which may become an important factor in the removal of fragments and foreign bodies. It is particularly hoped that the method will prove satisfactory and add to the contributions of dentists in the field of medicine and surgery.

After the examination, one would expect, and the temptation is great, to carry out immediate surgical débridement, and to approximate the lacerated structures. Instead, it has been found that conservative operative measures materially shorten the period of convalescence, and prepare the patient for more satisfactory plastic procedures at a later date. Prevention of complications and combating of infection are of much greater importance. Adequate nursing care and dressing of the wounds must be considered. Judicious surgical débridement, cleansing of the wounds and suturing at the proper time are of the greatest importance. The cleansing element universally advised is soap and water. Antiseptics are more often harmful than helpful.

Débridement aims to remove damaged tissue by excision. The extent of removal is determined when the tissues look normal, when the tissues bleed and when the tissues contract (if muscle). Nerves or tendons encountered should be sutured with silk.

The primary consideration for the dental officer, in the early treatment of every jaw fracture, must be the ultimate restoration of dental function. The early treatment should be such as to assure every chance for restoration of the original occlusion or of function, even in those cases with loss of considerable bone. It is particularly important to avoid the collapse of bone segments. Many of the horrible deformities resulting in past war experience from failure to maintain bone segments can be avoided in the future, if the dental officer renders the proper type of treatment at the first aid and emergency stations. Often, bone particles that still have periosteal attachment can be useful in the later stages. It must be remembered that the conservation of small particles of bone with living at-

tachments may make all the difference between new bone formation with restoration of function, and the collapse of fragments with attendant complications. Even comminuted viable bone should be saved.

A conservative approach in surgical procedures has been proved to be the safest way to start the patient on the road to early recovery. Establishing free drainage and patiently waiting for Nature to separate the bone which is dead from that which is living will be a guide for further surgical work. When Nature is ready to cast out the dead bone, then and only then, sequestra should be removed. Emphasis must be placed on the necessity of maintaining drainage, and the surgeon must consider the advisability of providing submandibular drainage at the outset by insertion of tubes or gauze at the most likely site.

Nursing care should be carried out by individuals with special training in maxillofacial surgery. Nurses should be chosen for their specialized work. Open wounds become clean very quickly, but frequent warm fomentations are often necessary. The nasal passages and mouth should be freed from irritating and infected agents as nearly as possible by the application of irrigating solutions. The position of the patient is important, and these patients are more comfortable and in better position for treatment if kept more or less in a sitting position. It is also of utmost importance that an emergency surgical kit be close at hand at all times, for many of these wounds have a tendency to severe secondary hemorrhage. If any bleeding is reported in these cases, it is imperative that the oral surgeon put aside all other duties and attend to the bleeding immediately.

An immediate emergency tracheotomy may be necessary, especially if the soldier has been hit by a rifle bullet, entering one side of the face near the angle of the jaw and passing through the root of the tongue and through the opposite side of the mandible, with severe resultant edema of the tongue paralyzing the air passages. Tracheotomy is a life-saving measure, and one should be equipped to perform the operation at a moment's notice and under varied conditions. The surgeon should not procrastinate, but should perform a tracheotomy early. General anesthesia is contraindicated. The region should be infiltrated with 1 to 2 per cent procaine. Sedatives should not be given, especially morphine. In performing a tracheotomy, we must remember the landmarks of the neck and keep in the midline. With the head extended, the lower operation is preferable. If possible, stabbing of the cricothyroid membrane or cartilage must be avoided. In emergency tracheotomy, every moment is valuable. The condition often may not permit even the sterilization of instruments. After-care, which is often neglected, is extremely important.

Experience with these injuries has taught us that there are certain areas in which bleeding may be very serious. Any wound involving the floor of the mouth is apt to be very vascular. In this instance, the bleeding is from the lingual artery. Occasionally, ligation of this artery in the neck is necessary. Any injury along the posterior part of the nasal septum is liable to bleed because of an injury to the sphenopalatine artery. Injuries to the cheek may bleed because of laceration of the facial artery. The inferior dental artery, internal maxillary artery and posterior palatine artery may all be involved in serious hemorrhage.

Facial injuries often involve laceration and trauma of glands or glandular ducts. These structures must be given attention so as to insure their special function. Care must be taken to avoid injury to blood vessels and nerves in the field. Slight trauma to a nerve can lead to permanent paralysis, atrophy or deformity of the part that it supplies.

Feeding these patients is frequently a

problem. They are given liquid foods, and those who are able to use the masticatory apparatus can have a semisolid or even a regular diet. If there is an extensive wound, feeding can be done by the use of nasal tubes. It is, therefore, very important that the dental officer acquaint himself with the technic involved in passing a nasal tube. In exceptional cases, a direct opening is made into the stomach, a procedure known as gastrostomy. Fortunately, this type of case is not frequent. Occasionally, intravenous feeding of glucose is the only way by which the patient can receive nourishment.

CHEMOTHERAPY ELEMENT

After débridement, a sulfa drug is liberally applied to all exposed surfaces. Sulfa products should be used only in granular form, as this renders them less occlusive than heretofore. It is possible that a new product called penicillin may displace the sulfa drugs in bacteriostatic control. Col. Edward A. Doisy, whose research on theelin and vitamin K are widely known, has done some notable work with the antibacterial substance called penatin, which is similar to notatin, a yellow enzyme obtained from penicillium. Penicillin has been administered experimentally in several cases of general infection with excellent results, the most notable improvement over the sulfa drug being that its use has no toxic reaction. It is suggested that sulfathiazole be given orally in dosages of 15 grains every four hours for three days after the operation or trauma. Constitutional effects from the drug can be avoided if the urine output is kept at 1,000 cc. daily.

Fixation of bony fragments is carried out, by the simplest possible method, at the earliest possible moment. Early splinting will tend to avoid sepsis, as lack of immobilization predisposes to infection, which may destroy the bone-forming structures. For example, a band and bar splint can be used when there is a fracture with loss of the anterior part of the mandible, and with teeth remaining in each segment after the injury. Modifications of this type of splint may be devised when there is more extensive comminution or loss of teeth on one side. Condylar fractures usually do not cause much concern, immobilization being all that is necessary. Of utmost importance also, at this time, is the application of some form of support to the soft tissue so that, when healing occurs, there will be no extensive contracture as a result of scar tissue formation. This part of the treatment is very important since the procedures carried out by the plastic surgeon at a later date can be performed with greater success if the healing tissues are given a mold about which to form, in as nearly their normal relations as possible. We must stress again the necessity of establishing adequate drainage throughout treatment.

Anesthesia may not be necessary until definitive treatment of the wound is carried out. At this time, local anesthesia may be used to great advantage. When foreign bodies deep in the tissue are sought for, usually no other anesthetic is needed. Intratracheal anesthesia is of great value provided a trained anesthetist is available, and if the injuries to the mouth are not too severe. Intravenous anesthesia by means of pentothal sodium is preferred by some. However, because these operations are frequently time-consuming, this anesthesia is not so valuable as in short operative procedures, and is not the anesthesia of choice in extensive wounds.

In summary, it may be said that, in extensive gunshot wounds of the face, there are several important principles to be followed, and certain conditions to be anticipated and guarded against: 1. Prompt and adequate treatment of the general physical condition immediately after the injury. 2. Careful examination of the local injury and determination

of the amount of tissue destruction and loss. 3. Avoidance of radical débridement and immediate closure of these wounds. No tissue should be removed that can possibly be preserved. 4. Careful observation for bleeding and provision of suitable instruments to control secondary hemorrhage. 5. Adequate nursing care with specially trained personnel, the use of continuous warm fomentations, judicious use of chemotherapy, proper feeding and routine hygienic care of the mouth and nose. 6. After the apparent danger of infection has subsided, careful suturing of the wound and approximation in as nearly normal position as possible, maintaining the soft tissues in position by means of prosthetic appliances so that contracture of the healing tissue is minimized, and thus allowing the plastic surgeon as much tissue material as possible with which to carry out the various reconstructive procedures.

This treatment is possible only if there is close cooperation between the medical and dental officers. Experience in the last war clearly indicated the necessity of developing special groups for the treatment of maxillofacial wounds. This group usually consists of oral and plastic surgeons, orthodontists and prosthetists especially trained in surgical prosthesis. At Barnes General Hospital, St. Louis, such a team has been functioning. For this reason, the Army is instructing both dentists and surgeons alike in these fundamental principles so that disfiguring deformities and permanent invalidism can be prevented.

The foregoing is standard among war surgeons in all theaters of war at the present time, and there is a complete unanimity among war surgeons in subscribing to these procedures for wounds of the soft parts or elsewhere.

It can thus be concluded that these simple procedures, judiciously and conservatively used by physicians and dentists, will greatly reduce fatalities and assure results that will be a basis for the work of the plastic surgeon when the patient is returned home or to the interior for final treatment.

My experience in handling maxillofacial injuries in France during World War I proved that, unless these jaw and face cases are watched and treated carefully from the beginning, much unnecessary grafting will be needed later. Statistics show that 11 per cent of fracture cases in the other war needed bone grafting, and that three months was usually necessary before bone grafting could be attempted. This time factor may be greatly changed today. In our experience at Barnes General Hospital with maxillofacial injuries, as severe as those I saw in World War I, there has been a decided decrease in the time necessary to clear up infection, probably owing to the use of sulfa drugs. After a week or ten days, most of these cases have been infection free. We have, however, experienced the same difficulty encountered with exfoliation of spicules and tooth particles, and also shell fragments.

The teeth that happen to be in the line of fracture may be retained temporarily for fixation, but these teeth should be removed as soon as fragments and muscles are satisfactorily immobilized. Bone consolidation usually takes place rapidly when a tooth or bone spicule is removed from or near a fracture line. A wide gap is frequently bridged by bone formation.

After six months of freedom from sepsis, bone grafting and plastic procedures may be instituted. Preliminary scars should be treated by this time and the parts rendered mobile. The choice of the donor bone rests largely with the surgeon, but experience has taught that the best is the ilium. The bone graft is usually taken from the crest of the ilium. The tibia is the source for the osteoperiosteal graft. A rib will yield the bone for an osteochondral graft and a

pedicle graft can be made from the mandible. There are two principal mandibular grafts, the overlapping graft, which partly abuts on and partly overlaps the freshened mandibular fragments, and the block graft, which shapes the bone accurately to abut on the freshened mandibular elements. It must be remembered that drainage should be provided in the donor area. In the recipient area usually no drainage is required.

This procedure should be followed only at a fully equipped general hospital designated to receive maxillofacial injuries, and where space has been set aside for the functioning of a well-trained and experienced maxillofacial team. In favorable cases, reconstruction will be undertaken at the earliest possible moment. Procedures will be instituted leading to correction of malunion, plastic procedures, bone grafts and the construction of dentures and appliances necessary for restoration of normal occlusion and the ultimate dental function.

The return of the injured, fully reconstructed, to society will then be without embarrassment to the individual, and the medical and dental branches of the service will receive the plaudits of the professions and the public for work well done.

THE EFFECT OF MIXING SURFACE TEMPERATURE UPON DENTAL CEMENTATION

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CONTRARY to prevailing opinion, painful cementation is mainly due to the thermal conductivity and low temperature of both the fluid cement and the casting. Also, when mixed to a prescribed consistency for inlay cementation, i.e. according to the directions of the manufacturer, fluid cement from a cold mixing surface becomes warmer and sets faster in the mouth than a similarly mixed cement from a warmer slab. A cementation technic is here suggested to diminish pain, while permitting added strength and greater convenience.

These statements may be a little startling, but they are substantiated by the experiments described below. This work has been performed over a period of four years. In the beginning, hundreds of miscellaneous mixes of oxyphosphate of zinc cement were made, but the results lacked scope and homogeneity. About a year ago, a better and more logical plan took shape, and the necessary apparatus, although it seemed complicated, really simplified the entire research. A more complete discussion of pain and causes of pain from cementation is contained in another paper. Here the emphasis will be upon the mixing technic.

EXPERIMENTAL PLAN

One purpose of this experiment was to determine the effect of various temperatures of both the mixing surface and the postmixing environment (setting environment), and their separate and combined influence, upon working and setting time. Another important purpose was to determine the varying amount of cement powder that could be safely incorporated in the same amount of cement liquid at different temperatures while attaining

an identical inlay setting consistency. The strength and insolubility of dental cement increases as the proportion of powder to liquid increases up to 2.0 gm. : 0.5 cc.,[1] and since practical inlay setting consistency rarely approaches this ratio, an aim of the experiment was to indicate the probable strength and durability of cements mixed at different temperatures.

The special hollow glass mixing slab used will be described later. With this slab, it was possible to set and maintain the mixing surface at any practical temperature. Two popular brands of oxyphosphate of zinc cement were employed in the tests, and 0.5 cc. (about 15 drops) of cement liquid was used, as bulk was desired. The mixing procedure was that advised by the manufacturer. Each small portion of powder was thoroughly incorporated before more was added. The average time for the completed mix was from two to three minutes, depending on slab temperature. (This will be discussed later.) Since this study was made under practical operative conditions wherein the powder : liquid ratio is not constant, in all experiments small portions of cement powder were added and spatulated until a typical inlay-setting consistency was obtained. With a little practice, using measured amounts of both liquid and powder and a constant temperature for the mixing slab, the usual stringing test for the fluid cement was sufficiently standardized for experimentation.

In the actual tests, 2.0 gm. of cement powder was weighed out for each mix. After spatulation, the remaining powder was subtracted from the original 2.0 gm. and the amount of powder used to reach the consistency standard was recorded. Mixes were completed on surfaces varying from 40 to 100° F. This range was believed comprehensive enough to cover mixing technics under conditions varying from refrigerated slabs to mixing surfaces at summer room-temperature. Naturally, the dew point was always con-

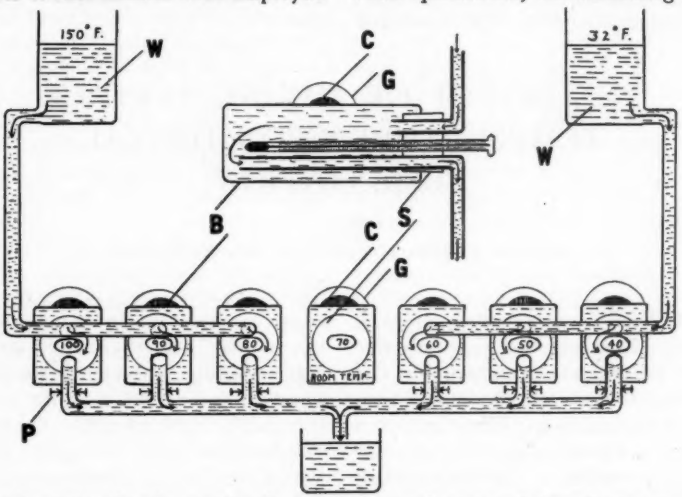

Fig. 1.—Apparatus for zinc oxyphosphate cement experiments; end view of seven quart bottles in which hot and ice water was circulated so that upper side of each bottle was at different but predetermined temperature—10-degree intervals from 40 to 100° F. Central schematic drawing: Cross-section lateral view. B, water-filled flat-sided quart bottle used as cement slab. C, cement specimen. G, cover glass. P, pinch-cock to regulate flow of hot or ice water. (By allowing escape of water, hot or ice water was admitted to keep the temperature constant.) S, rubber stopper, three holes: for inlet, outlet and thermometer. W, water.

sidered, and condensation of moisture on the mixing surface was not permitted.

PROCEDURE

In all, seven quintuple mixes were made, each group of five at a different temperature. When spatulation of each mix was completed, it was rapidly divided into seven parts and placed upon seven slabs at 10° F. intervals. To illustrate: A mix was spatulated on a slab at 40° F., and when typical stringing consistency was attained, it was divided into seven portions. One was left upon the mixing slab at 40° F., a second was transferred to one at 50° F., the third to one at 60° F., and so on at 10-degree intervals, the seventh portion being transferred to a 100° F. surface. The beginning and the end of mixing was timed and recorded, as was the time of application of the mixed cement to the 100° F. setting environment, and also the setting time for each specimen. Then four confirming mixes were made, in sequence, each at 40° F., as in the first mix, and similarly divided into seven portions on the seven slabs. A schematic

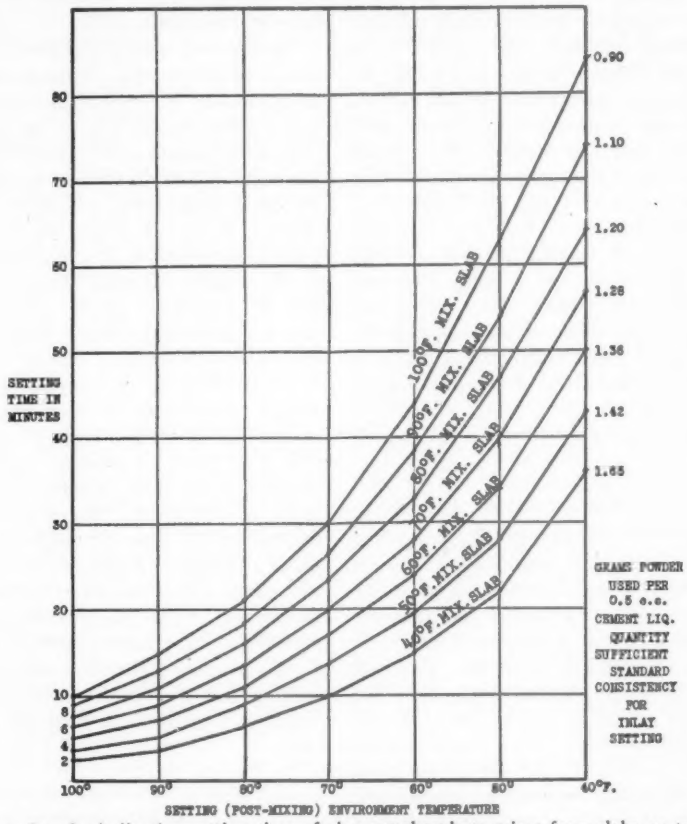

Fig. 2.—Results indicating setting time of zinc oxyphosphate mixes from slabs 40 to 100° F. Relative safe working time at different temperatures and amount of powder incorporated may also be read. It is to be noted especially that cold mixes set faster than those from warmer slabs.

drawing of the apparatus used is shown in Figure 1.

An average of the five mixes was struck, and the results graphed. (Fig. 2.) Next, five mixes were spatulated on surfaces at 50° F. and divided as in the first set of five with one intervening variation. To circumvent a source of error—the partial setting of the mixed cement during the fifteen to thirty seconds while it was being divided—the entire mass mixed on slabs from 50° F. to 100° F. inclusive was transferred to the 40° F. surface and divided upward from there. The next mix was made at 60° F., and so on, at 10-degree intervals. In all, this experiment yielded 245 specimens from the thirty-five mixes ($5 \times 7 \times 7 = 245$).

The cement was spread out on each slab and was not left in bulk. This was to simulate the setting of an average inlay under practical office conditions. In each test of this group, the setting time was determined when the passive weight of the Gilmer needle no longer indented the glossy surface of the setting cement.

OBSERVATIONS

Both the expected and the unexpected were found in this work. Of course, it was observed that a postmixing or setting environment of a higher temperature than that of the mixing surface accelerated the setting time, but this was especially evident when the cement was mixed on a cold slab. The latter fact will be explained later. Thus, cement transferred to a 100° F. slab would set from thirty-three and one-half to seventy-four minutes before a portion of the same mix left on a 40° F. surface. Increasing the postmixing environmental temperature 60 degrees (from 40° F. mixing slab to 100° F. setting environment) caused enormous acceleration in the setting of mixed cement. But this was proportionately true even when the jump was only from 60 or 70 to 100° F. (average slab to mouth temperature). At 100° F., the fluid cement from a 50° F. slab may set in three and one-half minutes, at 90° F. in five minutes, at 80° F. in nine minutes, at 70° F. in thirteen and one-half minutes and at 60° F. in nineteen and one-half minutes. The cement at mouth temperature (between 90 and 100° F.) set more than three times as fast as that portion which was left at average room temperature, 70° F.

By selecting a fixed postmixing (setting) environmental temperature such as 95 or 100° F. (oral temperature) and reading the graph (Fig. 2) vertically, an unexpected observation becomes possible. Cements mixed at lower temperatures set faster than those mixed on warmer slabs. The speed of setting was somewhat proportionate to the temperatures of the mixing surfaces. Thus, a mix at 50° F. sets hard three and one-half minutes after transference to a 100° F. environment; whereas a mix at 80° F. takes about nine minutes to set under similar conditions. Slaking, the partial neutralization of the liquid by the addition of a speck of powder two minutes before actual mixing, is generally thought to delay setting time, but this is not literally correct. True, crystallization is delayed, but only as long as the mix remains in contact with a cool or cold slab. When the cement reaches the mouth, where the environmental temperature is 90 to 100° F., the reverse occurs if a standard consistency mix was attained. A slaked mix then sets slightly faster than an unslaked one.

CEMENT STRENGTH VS. SLAB TEMPERATURE

It has been recognized for some time that the compressive strength of dental cements is enhanced as the powder: liquid ratio increases up to 2.0 gm. of powder to 0.5 cc. of liquid. This fact led to determining the relationship between the mixing temperature and the amount of powder that could be incorporated in the mix. It was observed that to reach a

standard stringing consistency, more powder was necessary on cold surfaces than on warm ones, and since small equal portions of powder were always added, the use of a cold mixing surface considerably lengthened the mixing time. Within the range of the experiments, from 40 to 100° F., doubling the slab temperature reduced by about 35 per cent the amount of cement powder used to insure a standard inlay consistency.

OBSERVATIONS

The first important observation was the extreme retardation in setting time and the simultaneous lengthening of working time of well-spatulated cement on cold mixing surfaces. This retardation by cold can be extended almost indefinitely by storing completely mixed unset cement on dry ice (solidified carbon dioxide). (This is routine at the Murry and Leonie Guggenheim Dental Clinic.) Until the mixed cement is removed, the temperature of the mixing slab becomes that of the postmixing environment. It is easily seen that a cold mixing surface increases the safety and working time of the mixed cement as long as it remains in contact with the slab. The effect of the cold surface is to keep the cement "young," fresh and plastic. Once removed from its protective environment, the cement sets and becomes "aged" and brittle.

The finding that cement sets with more than three times the rapidity at oral temperature that it does at room temperature indicates a definite procedure in the method of cementation. The relatively high temperature of the mouth causes crystallization to begin almost immediately, but at room temperature, and especially on cold slabs, setting is greatly retarded. It would therefore seem unwise to apply cement to the cavity before it is coated on the casting because of the disparity in their respective temperatures.

A handle can be attached to an inlay just prior to cementation to facilitate the application of cement and its placement. This may be a toothpick fastened to the occlusal surface of the inlay by a bit of sticky wax and angled for convenient insertion in the cavity preparation. This permits the casting to remain at room temperature and does not allow it to absorb heat (or grease or moisture) from the operator's hands. Cement can now be applied to the inlay, and, if practical, the metal can be placed on the chilled mixing surface for further heat absorption and retardation, while the cement is carefully teased into the cavity to avoid trapping air. The inlay can then be inserted via the toothpick, which is snapped off when the casting is almost seated. Final pressure can be applied with full confidence that only plastic uncrystallized cement exists under the seating inlay.

Next, it was noted that cement mixes from cold slabs set faster than those from warmer surfaces. This seemed contrary to prevailing opinion, but the explanation is simple. Spatulation involves two distinct processes: the mechanical mixing and the chemical union of the powder and the liquid; the latter process requires energy for its continuance. As a result, cold slab spatulation produces, for the most part, a mechanical mixture. When the mixing surface is warm, there is more chemical reaction during spatulation, with liberation of heat. This heat becomes part of a cycle, which continues the reaction so that some crystallization occurs, the mass thickens and the desired consistency is reached sooner than on a cold slab. Thus, less powder can be incorporated in a mix on a warm slab than on the cold one. And "warm" is relative: a 70° F. room temperature surface is warm as compared to a 40, 50 or 60° F. mixing slab.

The relatively mechanical mixtures (not chemical reactions) that are possible at low temperatures (on cold mixing surfaces), in slow or slaked mixes,

or in combinations of these, permit the incorporation of large quantities of powder as compared with similar mixes at higher temperatures, or faster or unslaked mixes. These mixes, although of similar consistency, are deceptive. It has been shown[2] and we all recognize that thick mixes set faster than thin ones. The delayed cold slab mix is really an almost completely uncrystallized heavy mix, given identical postmixing environments. The current erroneous concept that use of a cold mixing surface results in a delayed mix arises from confusion of mixing temperature and postmixing (or setting) environment temperature.

In other experiments, large quantities of cement were mixed at different temperatures and the temperature of the fluid mixed mass was measured as it remained on the slab. Regardless of the mixing surface, if the spatulation was normal, the temperature of the mixed cement closely approximated that of the room. Since we know that contact with average room temperature (70° F.) isotonic salt solution causes pain to vital dentin,[3] we can expect a similar sensitivity from cement, with one alleviating difference: Salt solution and mixed plastic cement are good conductors of thermal shock, but the conductivity of this cement decreases with increased incorporation of powder. The use of thick, putty-like mixes for insulating bases cause no pain. Therefore, it seems indicated that cold mixing surfaces, which permit the incorporation of more powder, should be used because of convenience and strength, and, lastly, the diminution in pain due to the accompanying decreased conductivity, which limits to the rest of the fluid cement and to the relatively cold metal casting (70° F.) the absorption of heat from the tooth.

Further experiments to measure the heat generated or liberated by the setting cement will be described elsewhere. For the present, it is sufficient to report that the highest temperatures produced were only slightly beyond the upper limit of the thermal tolerance zone[4] of 130° F.

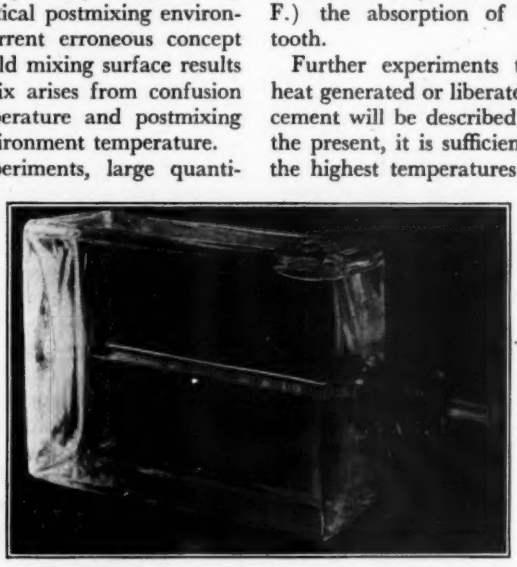

Fig. 3.—Water-filled flat-sided 8-ounce bottle fitted with rubber stopper and thermometer.

The cement mixed on the coldest slabs (40° F.) set faster and became hotter than any other, although the highest temperatures reached were from 103 to 135°F., depending upon the original environmental temperature. When left in bulk (in contrast to a film), the autogenous heat of the setting cement, instead of escaping, gradually raised its own environment to between 103 and 135° F. It is doubtful whether the maximum heat of 135° F. could cause pain under conditions of cementation, for although slightly above the high point of the tolerance zone of thermal control, it

is reached slowly and gradually over a period of four minutes.

THE MIXING SURFACE

The mixing surface used routinely in my office and in these experiments is a convenient one and of general application. Glass slabs are difficult to chill adequately, and a low temperature, even when attained, cannot be maintained because the specific heat of glass is less than 0.2. In addition, the surface of a cool slab warms first in the room, and it is upon this surface that the cement is mixed. In the so-called thermometer temperature control slabs, in which a thermometer is buried in the thick glass slab, it is separated from the mixing surface by insulating glass and does not reflect the true mixing temperature. Water has a specific heat of 1.0—five to six times more stable than that of glass—and is much more difficult to both heat and cool. It has the highest specific heat of all substances. Therefore, cold water should be a component part of the mixing surface, a hollow glass slab filled with water. We use flat-sided sharp-edged 8-ounce bottles of a size which compares favorably with that of dental mixing slabs. (Fig. 3.) A thermometer may be thrust through the stopper and the bottle filled with cold water. Here, agitation, conduction and convection currents equalize the internal and surface temperatures. For the foregoing experiments (Fig. 1), we used larger (1 quart) bottles fitted with inlets and outlets for siphoning ice water or hot water and thereby maintaining all of the required temperatures.

SUMMARY

1. Painful cementation is due to the cold of both the fluid cement and the casting.

2. The best cementation is obtained on the coldest mixing surface that does not "sweat." The exact slab temperature depends on the operating room temperature and humidity (dew point).

3. Cold slabs yield warmer setting cements than warmer mixing surfaces. Approximately, for every 5 degrees that the slab is colder, the setting cement will get 1 degree hotter, when mixed to the same consistency.

4. The amount of heat generated from the setting of an "acceptable" mix is not excessive and is not a factor in pain or trauma.

5. Cold slabs yield faster setting cements. The lower the mixing temperature, the quicker the final set in the mouth.

6. The use of a cold mixing surface (40-60° F.) profoundly lengthens the safe working time of the mixed cement.

7. More powder can be safely incorporated on cold slabs, thus: half the temperature, one-third more powder.

8. The successful mixing of oxyphosphate of zinc cements is considerably endangered by hot, humid conditions since cold slabs cannot be used. Air-conditioning seems definitely indicated for summer or tropical practice.

9. When operating time is most precious, and the need is greatest for a successful and rapid setting, very cold slabs should be used, with very slow mixing.

10. The cementation technic herein advised diminishes pain and affords increased strength and convenience.

BIBLIOGRAPHY

1. PAFFENBARGER, G. C.; SWEENEY, W. T., and ISAACS, AARON: Preliminary Report on Zinc Phosphate Cements. J.A.D.A., 20:1960, November 1933. Zinc Phosphate Cements: Physical Properties and Specification. *Ibid.*, 21:1907, November 1934.

2. PAFFENBARGER, G. C.; VOLLAND, R. H., and SWEENEY, W. T.: Study of Zinc Phosphate Cements by Group of Practicing Dentists Under Direction of A.D.A. Research Fellowship at National Bureau of Standards. J.A.D.A., 21:1281, August 1935.

3. HENSCHEL, C. J.: Pain Control by Cold Control. *D. Digest*, 47:444, October 1941.

4. *Idem:* Pain Control Through Heat Control. *D. Digest*, 47:294, July 1941.

1235 Grand Concourse.

GLASS SLIDE PROCEDURE FOR DETECTING UNDUE ABRASION OF DENTIFRICES

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IN 1937, an article was published, entitled "A Specification for Toothpaste,"[1] in which were set forth the constituents of toothpastes acceptable to the federal government, and the physical properties required of such preparations. In 1940, these specifications were modified in certain details in a new "Federal Specification for Dentifrice; Toothpaste."[2] An essential part of these specifications was a test of the power of the materials to scratch a glass slide when rubbed with "a metal instrument having a surface similar to the curved surface of a 5 cent coin,—the metal instrument [to] be approximately the same hardness as the 5 cent coin." In making the test, the edge of the coin was rubbed 100 times over the surface of a glass microscope slide covered with the dentifrice, using a pressure of about 5 pounds. It was stated that "the amount of pressure used appeared to be relatively unimportant as long as contact between the coin and glass was felt from the rubbing motion."[1] In the modified specification, the pressure was reduced to 1 pound and the strokes increased to 100 double ones.[2] After the rubbing, the slide was cleaned with acid and examined for scratches. It was stated that the test was sensitive enough to detect 1 part of emery in 100,000 parts of paste. In a later publication, in which the method of performing the test was illustrated and discussed, it seemed that the pressure on the slide was only to be estimated, since no direct control of this factor was apparently maintained during the actual abrasion as described or illustrated.[3]

This procedure is apparently effective for testing dentifrices contaminated with even traces of highly abrasive materials, such as emery dust. So far, however, it has not been established whether it would be equally useful for revealing the presence of undesirable varieties of softer materials such as chalk of too coarse a particle size. Since the latter is much the more important type of improper constituent of dentifrices, the problem seemed worthy of investigation. The method, if it could be shown to be generally applicable, would be very useful as a simple quantitative test to rule out harmful products requiring no special apparatus.

The crux of the problem is to determine whether the amount of scratching produced on a glass slide by a given dentifrice is proportional to the abrasive power of that preparation for teeth; also to establish the conditions of this relationship.

As a result of a series of studies on the abrasive power of dentifrices and their ingredients as regards teeth,[4, 5, 6, 7] there was available a considerable number of materials the ability of which to abrade teeth had already been accurately measured. Therefore, some of these materials were used for glass-slide tests and the results compared with the effects on teeth previously published.

From the Department of Physiological Sciences, College of Physicians and Surgeons, a School of Dentistry. Work supported in part by grants from the American College of Dentists and the California State Dental Association.

METHODS

Non-corrosive glass microscope slides were used after they had been carefully cleaned and inspected for freedom from scratches. A 5 cent coin was mounted on the end of a stick of sealing wax, with the flat surface exposed. The slides were rubbed at the test weight for 200 strokes before the material to be tested was applied, to make certain that the coin did not scratch the glass. The material to be tested was put on the slide and the coin rubbed through it, with the wax sticks as a handle and with pressure for 200 single strokes. The dentifrice was continuously fed into the path of the coin so that it did not get pushed out of the field of action. After the rubbing, the slide was washed with water and then with aqua regia to free the glass of any powder or abraded metal, and dried. It was then inspected for the presence of scratches, and the relative intensity of scratching indicated by the number of plus signs ascribed to it. Three such slides were made for each powder, and each of these was read independently by two observers. The total score in pluses for each powder from the six results was taken as an index of scratching power. The abrasiveness of these materials for teeth, which had been published previously,[4, 6, 7] was expressed as a percentage of the abrasiveness of a special sample of precipitated calcium carbonate, U.S.P., used as a standard of reference. The results with various dentifrices are summarized as follows:

DRY POWDERS WITHOUT PRESSURE CONTROL

In the first series, twenty-one powders were used in the dry state without any control of the pressure exerted, beyond an attempt to keep it constant. The summated plus values ranged from the maximum of sixty from a highly abrasive silica to none with several individual ingredients. Plotting the abrasion of these powders on teeth against that observed on the slides showed that there was no regularity in the results, and correlation was completely lacking. This test demonstrated the necessity of considering the use of a moistening agent and control of the pressure by an objective method.

DRY POWDERS WITH CONTROLLED PRESSURE

In this series, the powders were left dry, but the pressure was controlled by putting the slide on one scale pan of an ordinary laboratory beam balance with either a 1,000 or a 1,500 gm. weight on the other scale pan. Pressure was then exerted on the coin in stroking, just sufficiently to counterbalance the weight. The same number of slides and strokes were used as before and the total possible score was 36 pluses.

The plotted data showed no correlation between the abrasion of teeth and scratching of the glass, with either degree of pressure. For instance, no scratches were caused by three powders of 158, 162 and 227 per cent abrasiveness for teeth, respectively, while heavy scratching of the glass resulted from other powders only about one-half as abrasive as the former. In view of these results, controlled pressure alone obviously was inadequate to bring about a correlation between the abrasiveness for teeth and the degree of scratching of glass.

PASTES WITH CONTROLLED PRESSURE

A group of twenty-five commercial toothpastes were used for the abrasion, without further moistening or dilution. Pressures of 500, 1,000 and 1,500 gm. were tested as previously. The glass slides were so graded that 8 pluses was the maximum degree of abrasion, such as might be caused by a coarse emery powder. The total possible score for the slides was, therefore, 48 pluses. The relative abrasion of these powders for teeth, which has been published pre-

viously,[6] ranged between 56 and 156 per cent.

Under 500 gm. pressure, practically no scratching was produced by even the most abrasive of the pastes. Apparently, this was not enough force to cut through the surface of the glass, regardless of the material being tested.

With a pressure of 1,000 gm., a relationship was present between the abrasiveness of the paste and the scratches, since there were more scratches caused by the materials most abrasive for teeth. The degree of this relationship was demonstrated mathematically by calculating the regression line and coefficient of correlation by the method of least squares. The results were: $y=93.4 + 1.01x$, $r= + 0.36 \pm 0.17$, where y was the abrasion for the teeth in percentage of the control, x the plus score on the glass slides and r the correlation coefficient. The formula showed that a minimum abrasiveness of 93.4 per cent was needed before scratching began. The correlation coefficient was approximately twice its standard deviation, so that there was some correlation, but it was not especially significant.

When the pressure was increased to 1,500 gm., the results were enhanced. The values found were: $y=85.8 + 1.55x$, $r= + 0.47 \pm 0.16$. In other words, over 85.8 per cent abrasiveness for teeth gave scratches on the glass, and the correlation coefficient now was significant beyond any reasonable doubt. The fact that the heavier pressure gave a zero value of 85.8 per cent as compared to 93.4 per cent for the 1,000 gm. force was the reasonable result of the greater pressure exerted, as was also the steeper slope of the curve indicated in the greater x coefficient.

These results indicated that when the dentifrice materials were in paste form, useful results could be obtained. Therefore, another series was run on tooth powders, the powders being moistened with just enough of a mixture of equal volumes of glycerine and water to give a thick slurry suitable for test.

MOISTENED POWDERS WITH CONTROLLED PRESSURE

A group of twenty-one powders made into a slurry were tested first with 500 and 1,000 gm. pressure. The correlation coefficient calculations showed that there was no reliable degree of relationship at these pressures. Repetition of the test with a load of 1,500 gm. gave much better results. The highest correlation of the study was observed, r being $+ 0.48 \pm 0.17$. The formula for the regression line was: $y= 45.14 + 9.26 x$. This indicated that no scratches would be produced at the level of 45 per cent abrasiveness for teeth.

LIQUIDS WITH CONTROLLED PRESSURE

A group of six liquid dentifrices were tested undiluted under all three pressure loads without any consistent scratching effects. Since these were less abrasive for the teeth than the mildest of the pastes and powders, such a result was consistent with the previous data.

COMBINED DATA FOR CONTROLLED PRESSURE

Since the best results were obtained with the heaviest load of 1,500 gm., and with the materials in a moistened form, the data for the pastes, liquids and moistened powders were combined to obtain a general picture of the relationship being studied. The scatter diagram shows the individual values for each of the fifty-two preparations, together with the calculated regression line. This was: $y= 67.8 + 4.65 x$, $r= + 0.40 \pm 0.12$. An abrasiveness of 67.8 per cent was, therefore, needed before the scratching began. The correlation coefficient is so large in proportion to its standard deviation that there can be no doubt as to the reliability of the correlation.

However, the figure shows that the range of scattering of individual values is great, the standard deviation of individual values from the line of regression being $\pm$ 89 per cent. It would, therefore,

appear to be almost impossible to use the glass slide to measure the abrasiveness for teeth of a given dentifrice, even though, when as large a series as the one here was tested, the average results did have a fairly reliable degree of correlation.

DETECTION OF TRACES OF HIGHLY ABRASIVE CONTAMINANTS

Souder and Schoonover doubtless recognized the limitations of the glass slide technic, since they only advocated or used it as a detector for scratching ability, without attempting to reduce this to any comparative or quantitative basis. It therefore seemed worth while to determine whether the test would detect traces of highly abrasive substances even when they were not present in sufficient quantities to have a great scouring effect. In this connection, Souder and Schoonover reported that the presence of 0.0001 per cent emery dust could be detected in dentifrices by the slides. In extending their observations, we determined how small a concentration of silica and flour of pumice was required to cause perceptible scratches. These compounds seemed to be of somewhat greater interest than emery dust, since they were much more likely to be found in dentifrices than the emery.

To the control calcium powder used throughout these studies was added 1 per cent of either "240 mesh" silica or flour of pumice from the specimens previously studied.[5, 7] The median particle diameters of the control and abrasive powders were 3.1, 10.5 and 15 microns, respectively, and the abrasiveness for teeth were 100 per cent, 5688 per cent and 4325 per cent. The glass slides were abraded with these contaminated chalks under a 1,500 gm. weight, with a moistened powder, as described above. A portion of each powder, if it scratched the glass, was mixed with an equal part of the original uncontaminated calcium carbonate, and thus the concentration of the contaminant was reduced by one-half, and the scratch test was repeated.

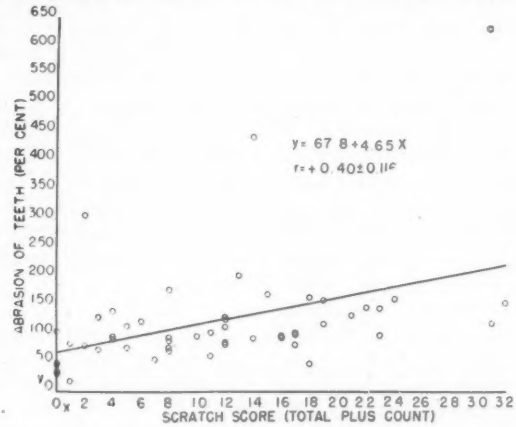

Fig. 1.—Scatter diagram and line of regression between the scratching of glass slides and abrasion of teeth produced by a number of dentifrices and dentifrice ingredients compared under standardized conditions.

It was found that silica was detectable at 0.0037 per cent, but not at 0.00185 per cent. Similarly, the lowest detectable concentration for the flour of pumice was 0.0156 per cent, with 0.0078 per cent indistinguishable from the control. These results indicate that, in confirmation of the earlier results on emery dust, very slight traces of highly abrasive materials

can be detected by this glass slide technic.

These threshold limits for the silica are particularly interesting in view of the earlier report of the threshold concentration of the same silica powder detectable by the abrasion of teeth procedure recently described by us.[4] In that paper, data were presented showing that the smallest amount of the same silica, detectable through increased wear on teeth, was 0.156 per cent. Therefore, it can be seen that the glass slide technic as described here was approximately forty-two times as sensitive for detecting traces of highly abrasive materials as was the more quantitative procedure of abrasion measurement.

It would appear that both procedures are needed, the tooth abrasion method for establishing the relative degree of abrasiveness of the whole preparation with a considerable degree of accuracy, and the glass slide test for detecting and eliminating those products which might be contaminated with a trace of a material which might scratch the enamel, but which was not present in sufficient quantity to increase markedly the total abrasive action. These data have, therefore, supplied the factual basis and proof for the earlier suggestions of Smith as to the probable significance of the two types of tests.[8]

CONCLUSIONS

1. The glass slide procedure of determining the abrasiveness of dentifrices has been subjected to a critical analysis in order to determine the degree of reliance that may be put upon it, and the optimum conditions for quantitative results.

2. If glass microscope slides are abraded with a 5-cent coin for 200 strokes under a steady pressure of 1,500 gm., there is a significant correlation of + 0.40 between the amount of abrasion of the materials for enamel of human molar teeth and the degree of scratching of the glass. For this test, the flat surface of the coin is used and the powders are moistened into thick slurries by adding a small amount of 50 per cent glycerine in water, while the pastes and liquids are used undiluted.

3. However, the curve relating scratching of the slides to abrasion on teeth is so flat, and the scatter of the individual results is so great, as to make it impractical to use the glass slide procedure for determining the absolute or relative abrasive power of an individual material for human teeth.

4. The main field of application of the glass slide procedure is to detect the presence of traces of highly abrasive materials, in keeping with the claims originally made for it by Souder and Schoonover. With the procedure described here, the presence of 0.0156 per cent of flour of pumice or 0.0037 per cent of a "240 mesh" silica in precipitated calcium carbonate may be detected through increased scratches on the slide. This test is, therefore, useful to help identify dentifrices that might scratch the enamel surface.

BIBLIOGRAPHY

1. SOUDER, WILMER, and SCHOONOVER, I. C.: Specification for Toothpaste. J.A.D.A., 24:1817, November 1937.

2. Federal Standard Stock Catalog, Section IV (Part 5): Federal Specification for Dentifrice: Toothpaste. FFF-D-191A, June 4, 1940. Superintendent of Documents, Washington, D. C.

3. SOUDER, WILMER, and PAFFENARGER, G. C.: Physical Properties of Dental Materials. Circular of National Bureau of Standards C433, 1942, pp. 177-179. Superintendent of Documents, Washington, D. C.

4. TAINTER, M. L., and EPSTEIN, SIDNEY: *J. Am. Coll. Dentists*, 9:353, December 1942.

5. TAINTER, M. L.; EPSTEIN, SIDNEY, and KLEIN, A: *J. Am. Coll. Dentists*, 1943. To be published.

6. EPSTEIN, SIDNEY, and TAINTER, M. L.: Abrasion of Teeth by Commercial Dentifrices. J.A.D.A., 30:1036, July 1943.

7. *Idem: J. D. Res.* To be published.

8. SMITH, M. L.: *Indust. & Engin. Chem.*, 11:155, March 15, 1939.

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SHORTAGE OF DENTISTS IN THE ARMED FORCES

THE shortage of physicians and dentists in the armed forces in the effort to recruit the Army and Navy of the United States to approximately eleven million men is becoming increasingly serious as the date agreed upon for the completion of that ambitious program approaches —January 1, 1944.

At the present time there are nearly 37,000 physicians enlisted in the commissioned Medical Corps and there are about 17,000 dentists commissioned in the Dental Corps.

The Army is provided with dentists at the ratio of one dentist to each 500 enlisted men in the service and it is only a matter of simple arithmetic to ascertain that for an army of eleven million men, there should be a corps of 22,000 dentists. To fulfil the dental requirements of the full Army quota, the Procurement and Assignment Committee must furnish more than a thousand dentists each month to the end of the year, and, in the same period, more than six thousand physicians must be procured.

Long ago it was anticipated that considerable difficulty would be met

in obtaining ample and full medical and dental service for the Army and, at the same time, avoiding any distressing shortage of medical and dental service to the civilian population. We are all quite conscious of our professional obligations to the armed forces; on the other hand, we have a definite and binding obligation to the civilian population. A year or more ago the Government realized that an inordinate demand would be created by the requirements for medical service to the Army and to the civilian population, and accordingly established the Procurement and Assignment Committee as an aid to the medical and dental professions in meeting these demands. The Procurement and Assignment Committee has functioned admirably in solving the problem until within the past few months, when the crest of physician and dentist supply seems to have been reached.

In an effort to stimulate more favorable responses from the available sources, the Committee has adopted various means, among them increase in the age limit for volunteer service. It appears, however, that appeal to patriotism has reached its saturation point of production, and it is evident that more drastic measures will have to be adopted if the Army is to obtain its quota of physicians and dentists. And, incidentally, there is no other thought in the minds of those conducting the war program than to complete the program in full and on time.

Confining our consideration strictly to the Dental Corps, it seems that there are many in the profession within the age limits who have not yet signified their intention or desire to volunteer for commissioned dental service. The procedure of the Procurement and Assignment Committee has been a most considerate one for dentistry, as have been practically all contacts of the army authorities with our profession. The Procurement and Assignment Committee has ascertained, through its established channels, the dentists who are eligible for the Dental Corps under the present age limits, and has invited these men to accept commissioned officer status in the Corps. We learn, however, that such invitations are not accepted in every case. In fact, about one out of every four dentists so invited has not responded in any way, which in its cumulative result leaves a shortage in the Dental Corps of several thousands.

We realize that the order for dental service in the armed forces is a large one and that it will severely tax the manpower resources of dentistry, but this demand must be met. We are at war, and every other consideration—family, business, self—becomes secondary to the war

effort. The men who have been drafted into combat service and who are making a magnificent fight for freedom—all four freedoms—were not invited to accept commissions as a preferred group. They were arbitrarily drafted into the service and gave up practically everything that was near and dear to them, with no such promise of reward as comes to those who are invited to accept commissions for rendering a specialized health service.

The Procurement and Assignment Committee has been lenient indeed in its indulgence toward those who have not responded to the various calls. It has not asked for nor has it been given police power to enforce compliance with its requests, but the indications are becoming stronger and stronger that pressure will be brought to bear upon both the medical and dental professions to accept these invitations to render specialized health service on a particularly favorable plane. In that event, we are fearful that those who are eligible for service and refuse will be reclassified and drafted into regular army line service. That is the alternative that the profession has strenuously endeavored to avoid from the beginning of the war program. All signs point to the abandonment of the temporizing methods in an endeavor to accomplish an all out war effort.

It seems that these same difficulties of volunteer service are being experienced also in the war industries, and ways and means are being considered to place the impelling and compelling power of service to government on a more dependable basis than that of patriotism.

The main difficulty seems to be that we are trying to fight a total war with voluntary control of the nation's manpower. In the desire to avoid compulsory measures, with all of the apparent discrepancies and injustices attendant thereon, we trust that every dentist who is within the professional and age specifications for dental health service in the Army will immediately offer his services to the Government in a patriotic spirit of cooperation, to the end that Dentistry may acquit itself in a manner befitting its ambitions and traditions as a health service to humanity.

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American Dental Association

MEETING OF THE HOUSE OF DELEGATES

OCTOBER 11-13, 1943

CINCINNATI, OHIO

★

THE opening session of the House of Delegates will convene at 10:00 a.m., Monday, October 11. The second session will be held at 2:00 p.m., Monday, October 11; the third session at 2:00 p.m., Tuesday, October 12, and the fourth session at 1:00 p.m., Wednesday, October 13.

The four sessions of the House of Delegates will be held in the Hall of Mirrors of the Netherland Plaza Hotel. The Credentials Committee will register Delegates and Alternates beginning 10:00 a.m., Sunday, October 10, at the Netherland Plaza hotel.

Reservations should be made direct with the hotel.

HARRY B. PINNEY, *Secretary.*

★

WAR SERVICE COMMITTEE
Public Session at Cincinnati

A PUBLIC session of the War Service Committee will be held in Cincinnati, Ohio, at the Netherland Plaza Hotel, on October 9, 1943.

Program

9:30 a.m. Call to order, by Chairman C. Willard Camalier
Opening Remarks by J. Ben Robinson, President

9:45 Brigadier General Robert H. Mills (DC), Chief Dental Officer, Medical Dept., U. S. Army, Office of The Surgeon General
"The Army Dental Service"

10:15 Rear Admiral Alexander G. Lyle (DC), U. S. Navy
(Subject to be announced)

10:30 Captain Robert S. Davis (DC), Chief of Dental Service, Bureau of Medicine and Surgery, U. S. Navy
"The Part Dentistry Is Playing in the Navy"

11:15 Major General Norman T. Kirk, Surgeon General, U. S. Army
"Dental Factors in Global Strategy"
(This address will be nationally broadcast from War Service Committee session)

Luncheon

2:00 p.m. Commander M. E. Lapham, Executive Officer, Procurement and Assignment Service, War Manpower Commission
(Subject to be announced)

2:30 Captain C. Raymond Wells (DC) USNR, Chief of Dental Division, Medical Dept., National Selective Service System; President-Elect, American Dental Association
"Present Status of Selective Service as It Affects the Profession of Dentistry"

3:30 Captain Marion W. McCrea (DC), Assistant, Medical Section, Curricula and Standards Branch, U. S. Army Specialized Training Division
"The Army Specialized Training Program, Including Discussion of the Selection of the Pre-dental Student"

4:15 Henry A. Swanson, Chairman, National Dental Salvage Committee
"National Dental Salvage"

4:30 C. Willard Camalier, Chairman, War Service Committee
"Dental Training Program for Disabled Veterans"

Dentists who expect to attend the forthcoming meeting of the American Dental Association are cordially invited to be present, as well as any other persons interested in the various subjects embodied in the agenda.

WAR SERVICE COMMITTEE,

GEORGE M. ANDERSON GERALD D. TIMMONS
H. C. JARVIS H. O. LINEBERGER
P. C. LOWERY OREN A. OLIVER
B. K. WESTFALL
C. WILLARD CAMALIER, *Chairman.*

BUREAU OF PUBLIC RELATIONS

DISEASES OF THE GUMS AND OTHER SUPPORTING TISSUES OF THE TEETH AND THEIR TREATMENT*

AT birth, the infant has no erupted teeth and the bones that form the ridges from which the teeth are to erupt are covered with a thin layer of soft tissue called mucous membrane. Because the membrane is smooth and unbroken, and so offers little opportunity for food lodgment or for development of bacteria, there is seldom any difficulty in keeping the infant's mouth clean and healthy. At about the age of 6 months, the teeth begin to erupt, and usually by the twenty-fourth to the thirtieth month, twenty deciduous teeth have erupted.

As they erupt, the teeth pierce holes in the mucous membrane, a free border of the soft tissues, like a collar, remaining around the neck of the tooth. This collar is not firmly attached to the tooth, but fits snugly about the tooth neck, forming a shallow crevice or groove between the gums and the teeth. This is called the gingival crevice and the collar itself is called the gingiva. It is this collar around the neck of the teeth that often becomes inflamed, the common condition known as gingivitis resulting. (Fig. 1.)

*The growth of public interest in dental health has resulted in a marked increase in requests for information on different phases of the subject. To meet this demand, the Public Health and Education Committee, now a committee of the Council on Dental Health, has authorized the preparation of a series of articles in pamphlet form, each article to deal with one of the dental questions most frequently asked by the public.

The current article, "Diseases of the Gums and Other Supporting Tissues of the Teeth and Their Treatment," by Edgar D. Coolidge, M.S., D.D.S., can be obtained in reprint form at a nominal cost by addressing the Bureau of Public Relations, American Dental Association, 222 E. Superior St., Chicago, Ill.

GINGIVITIS

Gingivitis is not commonly found in young children's mouths, but it is common in the mouths of adults and is occasionally seen during adolescence. The permanent teeth begin to erupt at approximately 6 years. At 16 years, there should be twenty-eight teeth. Sometimes, the third molar teeth (wisdom teeth) have erupted by that time, the complete denture of thirty-two teeth then being present. Thus, there are thirty-two holes pierced through the mucous membrane when all these teeth have erupted. Also, there are thirty-two collars and thirty-two gingival crevices where saliva, often saturated with sugar and other food particles in solution, can continually seep in and out. Mouth bacteria of both the harmless and the harmful variety thrive and multiply in the food débris that lodges in the protected crevices between the gingivae and the teeth.

In the healthy mouth, where the gingival collar fits snugly against each tooth and the gum tissue is firm and pink, there is a maximum of resistance to infection and a minimum of bacterial growth. (Fig. 2.) Should the gingival collar become irritated by dental calculus (tartar) or by food lodged between the teeth, the mucous membrane forming this collar becomes thickened and swollen. As a result, the gums become soft and red (inflamed) and they bleed when brushed. In severe cases, they may bleed when pressed with the tongue. (Fig. 3.)

Bleeding of the gums is a symptom of gingivitis, of which there are several forms. If the cause of the inflammation of the gum is the presence of dental

calculus (tartar) on the teeth, the bleeding stops immediately when the calculus is removed. Also, if caused by the packing of food between the teeth, inflammation can be cured by improving the contact of the teeth between which the food lodges. The contact can be improved by the insertion of an inlay or a filling. Sometimes, a crown must be constructed to bridge over the space where food continually lodges. Sometimes, the rough margin of an inlay or filling projects beyond the convex area of the tooth. This sharp edge irritates the gum and causes gingivitis in that area. Gingivitis will continue as long as an irritating margin remains.

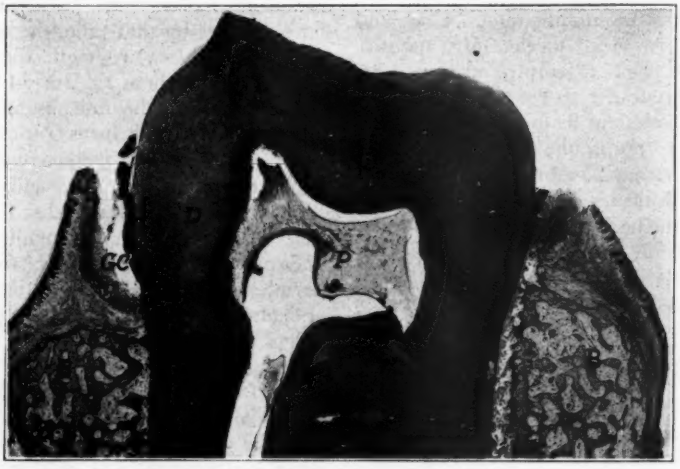


Fig. 1.—Gingival crevice of molar tooth (GC) filled with calculus (C) and infectious material. B, bone. D, dentin. P, pulp. G, gingiva. On the opposite surface of the tooth, no gingival crevice appears because the tissue is all attached to the tooth.

Bleeding of the gums caused by local irritation is usually quickly cured. Once the cause of the irritation is found and eliminated, the gums can be restored to normal with very little treatment. Because the film of soft calculus deposit is often very sticky, persistent and correct brushing of the areas between the teeth with a stiff bristled toothbrush at least twice a day is required to remove the film. Interdental toothbrushing was popularized by W. J. Charters.[1]

The Charters toothbrushing method is advocated by many dentists who specialize in the treatment of gum conditions. The toothbrush is placed upon just two teeth at a time. The bristles are vibrated with a short, firm motion between the two teeth. The procedure seems a little awkward and slow at first, but soon one learns the technic, and finds that the teeth feel very clean and the gums tingle with a stimulated circulation, which keeps them vigorous and healthy. Each space between the teeth is brushed in this manner on both the buccal side (side toward the cheeks) and the lingual side (the side next the tongue) of the teeth. The brush is not given a long stroke, but a short vibratory stroke, with considerable pressure to force the toothbrush bristles into the spaces between the teeth.

Children and young adults rarely need to employ this toothbrushing method because usually, at an early age, the gums or gingival tissues completely fill the spaces between the teeth. In most in-

stances, as middle adulthood is reached, the gingival tissues recede from the crowns of the teeth, vacant spaces remaining between the teeth to become lodging places for food and calculus. After the teeth have been brushed in this manner, the mouth should be flushed vigorously with water to remove all food particles and débris that have become loosened by the toothbrush. If the gums continue to bleed in spite of vigorous interdental brushing, the dentist should be consulted. Persistent bleeding of the gums in spite of thorough brushing of the teeth may indicate a mouth condition called Vincent's infection. This infection often becomes acute and painful when the general condition is not up to par and when the gums are not clean

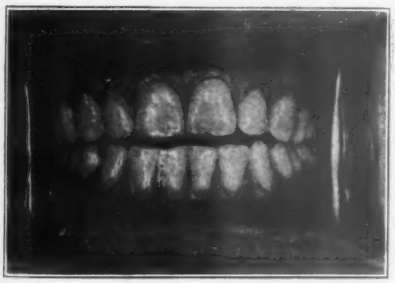


Fig. 2.—Healthy gingival tissue in woman aged 35. These tissues are in condition to resist infection.

and healthy. The organisms that frequent the mouth become pathogenic under favoring conditions,[2] as when the resistance is low and the gums are soft and spongy.

While softening and bleeding of the gums are usually the result of neglect or incorrect toothbrushing habits, there is some relationship between improper diet and soft gums. Nutrition, a broad subject, cannot be discussed in this article, yet every one should realize that the gum tissue requires certain foods to keep it vigorous and healthy, just as bone requires an adequate amount of calcium and phosphorus to keep it healthy. Every adult should know and every child should be taught that milk is needed for bone building all through life, and that grains, fruits and leafy vegetables, containing vitamins B and C, are needed daily for the health of the soft tissues, such as the mucous membrane of the gums and gingivae. Children who for economic reasons are denied essential foods are to be pitied, but children in

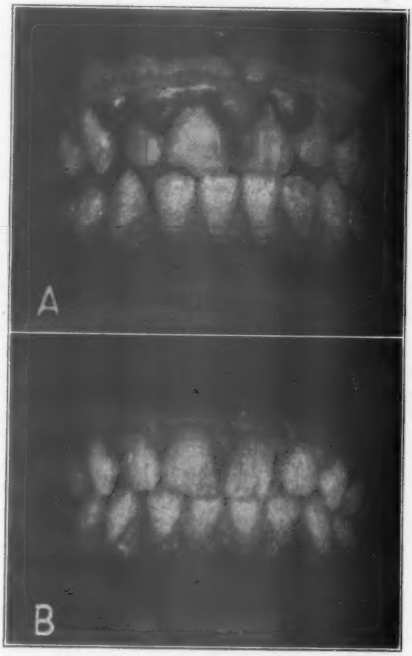


Fig. 3.—A: Teeth of middle-aged woman. Labial and lingual views show that the teeth are coated with dental calculus (tartar). B: Same teeth after scaling and removal of calculus, a common source of gingivitis and pyorrhea.

moderate or well-to-do circumstances who are allowed to grow up with no desire for the essential foods are equally unfortunate. Usually, the latter group copy the wrong eating habits of their parents or are allowed to overindulge in

candy and sweets, which destroys the appetite for essential foods.

HYPERTROPHIC GINGIVITIS

Hy-per-tro-phic gin-gi-vi-tis is another form of gingivitis that is frequently seen during the early adolescent years.[3] It may also occur during pregnancy. In this form of gingivitis, the gums, or gingivae, become thick and protrude from between the teeth until they present an unsightly appearance. (Fig. 4.) As the tissue grows thicker and more protuberant, brushing becomes more difficult, and the food and soft calculus deposits are permitted to remain around and between the teeth. The accumulating food débris and calculus irritate the gingivae and cause it to become inflamed. The inflamed gingivae become less resistant to harmful mouth organisms. The tissue soon becomes soft and spongy, and bleeds upon the slightest provocation, even when it comes in contact with food during the process of mastication. Toothbrushing is usually neglected or employed sparingly in this condition. This type of gingivitis may be started by a disturbance of the internal secreting glands. But, as the condition progresses, the gingivae become increasingly susceptible to local irritants, which become secondary, but nevertheless important factors in continuance of the condition.

Fig. 4.—A: Hypertrophic gingivitis in girl aged 15. B: Same mouth six months after treatment.

Hypertrophic gingivitis is curable, but its treatment requires considerable time and patience on the part of both patient and operator. Patients suffering from this type of gingivitis should be referred by the dentist to the physician for a complete physical examination. The adolescent soon becomes keenly interested in observing improvement in the gingivae, probably indicative of internal stimulation.

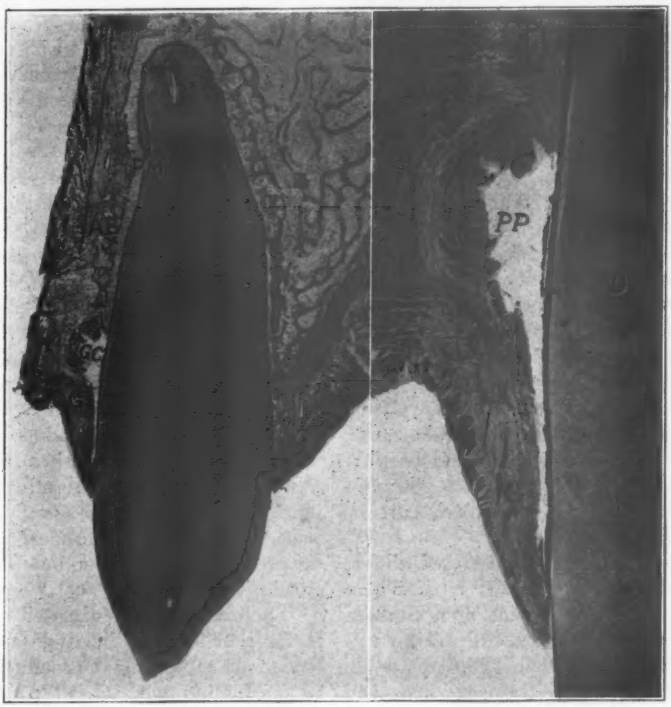
Hypertrophic gingivitis developing during pregnancy usually disappears soon after parturition if the gingivae have received local treatment by the dentist. The treatment often calls for surgical removal of some of the excess gum tissue.

PYORRHEA ALVEOLARIS (SUPPURATIVE PERIODONTITIS)

The term "pyorrhea" means flow of pus and "alveolaris" indicates the alveolar bone, which surrounds and supports the teeth. "Suppurative," a term that refers to the formation of pus, is technically more correct. When it is followed by the term "periodontitis," the formation of pus in the inflamed periodontium is indicated. The term "periodontium" includes a tooth and its alveolar and supporting bone, together with the connecting soft tissue fibers that are attached to the tooth at one end and to the alveolar bone at the other end. The periodontal tissue consists of short, but

strong fiber bundles arranged in six different groups, continuous with one another and extending from the bottom of the gingival crevice around each tooth to the apex of the root deep in the jaw bone. These fibers suspend the tooth in its socket like a basket hung in a well by many ropes, so when one bites upon anything, the pressure or blow is cushioned by these fibers, which prevent the tooth from pressing against the bone.

inflammatory condition increases and the deeper tissue becomes inflamed. Then the soft tissue begins to loosen around the neck of the tooth because of the irritating effects of tartar deposits. This loss of attachment of the tissue to the tooth root causes deepening of the gingival crevice, which now cannot be kept clean with the toothbrush and so becomes a pus pocket, or, as it is properly called, a pyorrhea pocket. (Fig. 5.)



A B

Fig. 5.—A: Pyorrhea pocket on labial surface of upper cuspid. D, dentin. G, gingival tissue of labial surface. GC, gingival crevice or pyorrhea pocket. AB, alveolar bone. PM, periodontal membrane. (After Kronfeld.) B: Higher magnification of pyorrhea pocket. D, dentin. G, gingival tissue. PP, pyorrhea pocket. AB, alveolar bone. (After Kronfeld.)

When dental calculus, or tartar, is allowed to gather upon the teeth, inflammation of the soft tissue about the necks of the teeth results. This condition is called gingivitis. If the calculus is allowed to remain and accumulate, the

Inflammation of the gingivae is a treacherous condition if neglected. The earliest symptom is bleeding. After a time, the bleeding ceases, and if the cause is not eliminated, the deeper tissue becomes involved. The blood stream

spreads the toxins and poisons arising from the presence of bacteria in the pyorrhea pocket into the bone that supports the teeth. Pyorrhea does not often spread directly from one tooth socket to another, but progresses into the bone around a tooth and causes the bone to be resorbed. This process gradually weakens the support of the tooth and eventually causes the loss of the tooth. Pyorrhea is sometimes confined to a single tooth socket, but in pyorrhea of the inflammatory type, usually several sockets or all are more or less involved. The inflammatory type of pyorrhea responds favorably to treatment in most cases and, with regular care by the dentist and interdental toothbrushing daily by the patient, it can be cured.

Generally speaking, there are two types of pyorrhea. The first type is caused primarily by the presence of dental calculus or other irritants of the gums and by infection. This is the type described above. Probably 90 per cent of all pyorrhea cases are included in this class, as stated by the eminent pathologist Bernhard Gottlieb.[4] This type of pyorrhea can be cured by elimination of the cause, dental operative treatment and prophylactic care. This treatment must be supplemented with thorough home care by the patient.

The second type of pyorrhea differs considerably from the first type. There is no bleeding of the gums, no accumulation of tartar on the teeth and no evidence of infection at first, but the teeth, which have appeared to be firm and healthy, suddenly begin to separate and drift apart. The anterior teeth are frequently affected. An unsightly space appears between two teeth, and often one or more teeth begin to protrude. Each month, the teeth move farther out of line and farther apart. Even x-ray films do not always reveal any disturbance that might cause the trouble or show the loss of bone characteristic of the first type or pyorrhea. From nine to twelve months after the onset of the disease, the bone begins to resorb rapidly and, at this time, x-ray pictures will reveal the effect and extent of the trouble, but not the cause.

The second type of pyorrhea, more uncommon than the first, is found at almost any age, but it is found most frequently in young and middle adult life. It is occasionally found during the adolescent years; more often during the period from 20 to 30, and still more often between 30 and 40 years in women, but later in men. It seems to be caused by a disturbance of or a deficiency in nutrition and may be related to the unbalancing of an internal secretory function which affects the bone-forming cells. Some dentists call it periodontoclasia. Others call it periodontosis, or diffuse atrophy of the alveolar bone.

It seems that people who drink little or no milk and thus have a low intake of calcium and phosphorus are particularly susceptible to this type of pyorrhea. Those whose intake of fruit and vegetables is extremely low also seem to be susceptible. This particular type of pyorrhea may appear during adolescence and during or after the child-bearing period. As a rule, men are not affected by it until late in life. It frequently develops when the system is undergoing some severe physical or nervous stress and strain.[5]

There are certain inherited characteristics that have a bearing on physical functions. It does not necessarily follow that children will inherit pyorrhea because one or both parents have it, but some of the children are liable to be susceptible. It should be remembered that this type of pyorrhea represents only a very small percentage of the total number of cases, and even these can be controlled, so that very few teeth need be lost because of the inherited tendency. Regular treatment and the cooperation of the patient in persistent care are required to control the disease. The pa-

tient's responsibility is greater in these cases because he must not only carry out vigorous home care, but also maintain a diet that will tend to correct any nutritional deficiency and promote bone building.

It is sometimes difficult to differentiate between the two types of pyorrhea. There are usually some symptoms of each type in every case of pyorrhea. There are varying degrees of nutritional deficiency as well as varying degrees of an inherited tendency in each family. In a family of five children, one may be susceptible and may inherit characteristics similar to those of the parent who has pyorrhea. This child may develop the eating habits of the parent who has pyorrhea. The sooner such tendencies to neglect one's normal nutritional demands are recognized and corrected, the less trouble will there be with the teeth in late years. Parents should not permit the child to develop dislikes for necessary foods that may have been disliked by them. Rather, parents should seek information from good dietitians and assistance from the dentist so that children will be well fortified for the years of stress that come to all at some period of life.

Other systemic conditions that are frequently characterized by the loss of teeth should be mentioned, but one must not get a wrong perspective as to the cause of this common disease of the supporting tissue of the teeth. The gums usually become diseased in diabetes and often the teeth loosen and have to be removed. In blood disturbances such as anemia, leukemia and agranulocytosis, the gums invariably are greatly affected; and in infectious diseases, very often the teeth loosen, apparently because the supporting bone is resorbed. The physical aging process is another factor in the loss of teeth. Parts of the body may age faster than others, and it is found that many persons suffer from an atrophy of the bone around the teeth which can be attributed only to the premature aging of the alveolar bone and bone-forming cells. Any of these hereditary tendencies or systemic disturbances may hasten and intensify the common causes of pyorrhea and make control of the disease more difficult. Any disturbance in the periodontal tissues (tissues surrounding the teeth) that causes a loss of bone support reduces tooth function. As the bony structure is resorbed, the stress of mastication often becomes too great for the tooth to withstand, not because the stress is increased, but because the support is weakened.

TRAUMATIC INJURY FROM OCCLUSION

The occlusion of the teeth should bring every tooth in one jaw into harmonious relationship with its antagonist in the opposite jaw. As the teeth erupt and come into occlusion with the teeth opposing them, the cusps of one fit into the grooves of the opposing tooth and the two teeth tend to stabilize each other in the best position to meet the forces of mastication. The greatest occlusal force is exerted vertically and the greatest resistance is developed to withstand vertical stress. While each tooth is supported by tissue and bone, holding it in its proper position, when stress is applied more horizontally than vertically a tipping force is exerted that is more difficult to withstand. It is seldom that each individual tooth in the arch receives an equal lateral or horizontal pressure as the lower jaw is protruded (moved forward) or when the masticating movements are carried out. When there is no food in the mouth, this uneven lateral pressure often exerts too much force on one tooth and it is pushed out of line when the teeth are closed tightly. Constant repetition of biting and pushing to get such a tooth out of the way causes damage to the periodontal membrane and bone around the root of the tooth. The root is held in its bony socket by the periodontal membrane, and when a

single tooth receives more force than the membrane can sustain, the root is pressed against the bony socket, and the pressure crushes the periodontal membrane. A sudden soreness of the tissue on the side of the root develops where the pressure is exerted and the tooth becomes tender to the touch. This is called pressure pericementitis[6] or traumagenic[7] or traumatic occlusion.[8] The injury would soon heal and the tenderness disappear were the injury not repeated frequently. Unless one of the opposing teeth is worn down or fractured to relieve the constant injury from this heavy lateral stress, the tooth gradually loosens, and eventually it is lost because of the injury to the periodontal membrane.

The dentist should always be on the alert to detect excessive stress upon individual teeth. The patient also should be conscious that a tooth seems to interfere with free movement of the teeth across each other in the usual masticatory movements of the jaw and should call the dentist's attention to such interference. The movements of the lower jaw should be free from interference from a malposed tooth or the high cusps of a tooth in proper position which tend to lock the teeth and obstruct masticatory movements. As adult life progresses, the continuous wear of the surfaces of the teeth in occlusion tends to level them off and make them slide over each other more freely. This is normal and advantageous, but if one tooth does not wear down so fast as its neighbors, it stands above them and is subjected to excessive occlusal stress, mostly horizontally or laterally. The supporting tissue around this tooth is damaged by pressure and the tooth may be loosened. Occlusal wear that is evenly distributed is usually a preventive of excessive stress. Uneven occlusal wear or excessive occlusal wear lead to discomfort and pain in occlusion and eventually to loosening of the teeth.

The correction of traumatic injuries from occlusal stress can be brought about in various ways. Orthodontic treatment may be indicated to realine the teeth in a better relationship to each other.

Orthodontic treatment is generally limited to children and young adults. In the mouths of most persons beyond 25, it is possible to establish a new relationship of the occlusal surfaces only by means of properly placed fillings, inlays, crowns and bridges. Injuries from occlusal stress are more common among those who have suffered the loss of one or more teeth, which greatly interferes with masticatory efficiency. As a result of inability to masticate properly or to masticate upon the teeth supposed to bear the heavy stress of mastication, the teeth that are not designed for such use are subjected to an overload which in time causes them to loosen. Replacement of missing teeth is a very important service in the prevention of injury. Simple adjustments on the grinding surfaces of the teeth can be made by the use of a carborundum stone on high spots and interfering cusps. This procedure, when properly carried out, wears away only the high interfering point and allows free movement of the teeth over each other during the masticatory movements of the jaw. Injury of the periodontal tissues is seldom observed in mouths in which the occlusal relationship is satisfactory and the teeth wear down evenly to permit the free movements of the jaw as the teeth glide over each other. When the supporting bone has been reduced by resorption, cusp interference becomes increasingly injurious in its effect upon the periodontal membrane, and greater care must be taken to relieve those teeth that obstruct masticatory movement of the jaw, to conserve their functional capacity, which is now reduced in proportion to the amount of support that has been lost.

Pyorrhea can usually be completely cured and its progress can be prevented by treatment and by regular prophylactic care by the dentist. Like most other

diseases, it can be cured more easily and with better results when the earliest symptoms of gingival inflammation are observed. Preventive treatment is extremely important when tendencies to injury or to periodontal disease are discovered. The faithful cooperation of dentist and patient is essential to the control of pyorrhea.

BIBLIOGRAPHY

1. CHARTERS, W. J.: Immunizing Both Hard and Soft Mouth Tissues to Infection by Correct Stimulation with Toothbrush. J.A.D.A., 15:90, January 1928.

2. APPLETON, J. L. T., JR.: Bacterial Infection. Ed. 2. Philadelphia: Lea & Febiger, 1933.

3. COOLIDGE, E. D.: Hypertrophic Gingivitis. J.A.D.A., 28:1381, September 1941.

4. GOTTLIEB, BERNHARD: Tissue Changes in Pyorrhea. J.A.D.A., 14:2178, December 1927.

5. TALBOT, E. S.: Interstitial Gingivitis and Pyorrhea Alveolaris. Toledo: Ransom & Randolph Co., 1913, pp. 97-200.

6. BLACK, G. V.: Operative Dentistry. Ed. 7. (Revision by Arthur D. Black.) Chicago: Medico-Dental Publishing Co., 1936, Vol. 4, p. 133.

7. BOX, H. K.: Prevention of Periodontitis. *J. Periodontol.*, 4:19, January 1933.

8. ORBAN, BALINT, and WEINMANN, JOSEPH: Signs of Traumatic Occlusion in Average Human Jaws. *J. D. Res.*, 13:216, June 1933.

CORRECTION

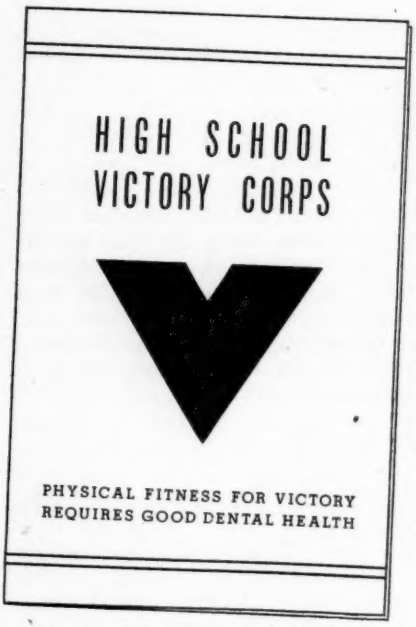
IN the article by Drs. Dean and Arnold in the August 1, 1943, issue, entitled "Endemic Dental Fluorosis or Mottled Enamel," on page 1279, the sentence "In view of this wide concentration range, the total fluorine intake of individuals using these different waters may vary as much as from 0 to 10 mg. per day," should read "In view of this wide concentration range, the total fluorine intake of individuals using these different waters may vary as much as 20 or 30 times."

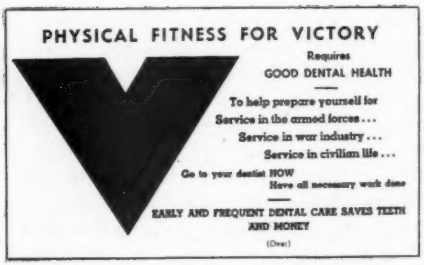
We duly apologize to the authors of the article for this inadvertent change in the manuscript.—ED.

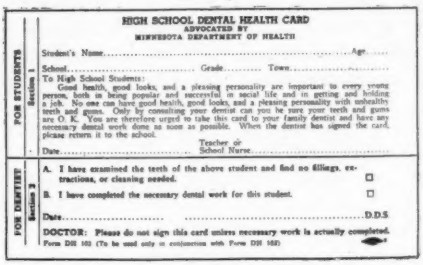
COUNCIL ON DENTAL HEALTH

VICTORY CORPS-PHYSICAL FITNESS DENTAL EDUCATIONAL MATERIAL

MINNESOTA was one of the first states to launch a dental health project in connection with the nation-wide High School Victory Corps-Physical Fitness Program, sponsored by the United States Office of Education.




PHYSICAL FITNESS FOR VICTORY
Requires
GOOD DENTAL HEALTH
To help prepare yourself for
Service in the armed forces...
Service in war industry...
Service in civilian life...
Go to your dentist NOW
Have all necessary work done
EARLY AND FREQUENT DENTAL CARE SAVES TEETH AND MONEY
(Over)


HIGH SCHOOL DENTAL HEALTH CARD
ADVOCATED BY
MINNESOTA DEPARTMENT OF HEALTH
FOR STUDENTS
Section 1
Student's Name..... Age.....
School..... Grade..... Town.....
To High School Students:
Good health, good looks, and a pleasing personality are important to every young person, both in being popular and successful in social life and in getting and holding a job. No one can have good health, good looks, and a pleasing personality with unhealthy teeth and gums. Only by consulting your dentist can you be sure your teeth and gums are O. K. You are therefore urged to take this card to your family dentist and have any necessary dental work done as soon as possible. When the dentist has signed the card, please return it to the school.
Teacher or
School Nurse
Date.....
FOR DENTIST
Section 2
A. I have examined the teeth of the above student and find no fillings, extractions, or cleaning needed. ☐
B. I have completed the necessary dental work for this student. ☐
Date..... .....D.D.S.
DOCTOR: Please do not sign this card unless necessary work is actually completed.
Form DH 102 (To be used only in conjunction with Form DH 102)

Left: Four-page illustrated folder for pupil reading. Right: Two sides of high school dental health record card.

Three pieces of educational material used in the Minnesota program are shown herewith. These consist of a four-page illustrated folder entitled "High School Victory Corps" for pupil reading; a high school dental health card, for the pupil's dental record, and a dental health school room report, for the classroom dental record. Copies of this material and information regarding costs can be obtained from the Division of Dental Health, Minnesota Department of Health, Minneapolis, or from the printers. The folder entitled "High School Victory Corps" is printed by the Syndicate Printing Company, 501 Seventh Ave. South, Minneapolis. The dental health card and the school room report are printed by the Bruce Printing Company, 2642 University Ave., St. Paul.

DENTAL HEALTH SCHOOL ROOM REPORT

Sponsored by

MINNESOTA DEPARTMENT OF HEALTH

Name of School..... School District Number..... County.....

School Year..... Teacher..... Town.....

INSTRUCTIONS TO TEACHERS.

(1) List in the spaces provided below the names of **all of your pupils** and the grade in which each pupil is enrolled. (2) Under "Date Given" write the date on which you gave each pupil a dental health card (Form DH 101 or DH 103). (3) Under "Date Returned" write the date on which the pupil returned his card **with the dentist's signature.** (4) At the end of the school year, send this report to your superintendent of schools, who will forward it to the Division of Dental Health, Minnesota Department of Health, University Campus, Minneapolis, for the purpose of statewide study of the dental health program.

Pupil's Name	Pupil's Grade	Date Given	Date Returned	Pupil's Name	Pupil's Grade	Date Given	Date Returned
1				21			
2				22			
3				23			
18				39			
19				38			
20				40			

Form DH 102 (To be used only in conjunction with Form DH 101 or DH 103)

Dental health report for classroom record.

ROUND TABLE DISCUSSION

MONDAY EVENING, OCTOBER 11

THE Council on Dental Health invites you to attend a round table discussion at 8 p.m., Monday evening, October 11, at the Netherland Plaza, Cincinnati, Ohio. The subject of the discussion will be "The Public's Dental Health Problem."

The panel will consist of the nine members of the Council on Dental Health. Emory W. Morris, chairman of the Council, will serve as moderator. Each panel member will present a brief statement regarding his committee's activities, after which the discussion will be thrown open for audience participation.

Because of the intense interest in Dentistry's participation in postwar planning, the Council anticipates that this meeting, to which all A.D.A. members are invited, will be one of the most interesting and valuable at the Cincinnati gathering.

COUNCIL ON DENTAL THERAPEUTICS

THE BUSINESS MANAGEMENT OF DENTAL MEETINGS IN THE LIGHT OF DECLINING REVENUE FROM COMMERCIAL SOURCES

JOHN J. HOLLISTER,* Chicago, Ill.

The Council has authorized publication of the following report.

DONALD A. WALLACE, *Secretary.*

THERE is no news in the statement that most dental societies, local, state and regional, are confronted with the very real problem of adequate financial support for their meetings. In the main, this stems from (1) conditions precipitated by the war and (2) the establishment of higher standards for participation in commercial exhibits.

Let us examine each of these separately. Since it is more dramatic in its impact upon the financial structure of meetings, let us look first at the war. Most commercial exhibitors fall into one or both of two categories: manufacturers and dealers in dental equipment and supplies, and manufacturers of items consumed by the public in which the recommendation of the dentist is sought as a matter of sales promotion. The first named, i.e. the out-and-out manufacturer of dental equipment and supplies, has been most seriously hit. Prior to December 7, 1941, he was an important factor in any dental society's exhibit picture. Now that the United States is operating on a full-war economy basis, he can no longer be counted upon to purchase exhibit space in anything like the same volume he did in the prewar years. In fact, his space purchases, in terms of booths bought, have declined from 50 to 100 per cent. While most dental equipment manufacturers recognize the necessity of maintaining their civilian contacts for exploitation in the postwar period, the fact remains that, right now, they have very little to sell. Moreover, practically all are beset with a multitude of problems which make large-scale exhibits at dental meetings for many of them impractical, if not impossible. The supply manufacturer's position is only slightly less difficult, and manufacturers of articles consumed by the public, such as dentifrices and food products, are suffering such severe manpower shortages that many have decided to forego exhibits at dental meetings for the duration of the war.

Then there is the other factor in the downward trend of exhibit space sales, which has resulted from the establishment of higher professional standards for participation in commercial exhibits. Time was when meeting managements were concerned more with the volume of revenue than with the character of some of their exhibits. Witness the exhibit booths of by-gone years from which subscriptions to lay magazines were solicited by persuasive salesmen. As often as not, subscribers failed to receive the magazines for which they had laid down their hard-earned cash. Then there were stock salesmen and last, but by no means least, the nostrum vendors. Happily, the lay magazine subscription salesmen went out with the late Great Depression. Happily too, there has been, in recent years, a

*Business Manager, American Dental Association.

strong tendency to oust the nostrum vendor in the interest of higher professional standards, leaving a financial problem for dental societies bent on solvent meeting operation. Thus we have the second important factor in the recent decline in volume from commercial sources.

The House of Delegates of the American Dental Association at St. Louis in August 1942 unanimously adopted a resolution urging that all state and local societies hold their annual meetings so that the dissemination of dental knowledge might continue in spite of the war. To the best of our knowledge, practically all the "regular" dental meetings are being held throughout the country complete with scientific sessions, clinics and scientific and commercial exhibits. That all have suffered loss of revenue can be taken for granted. However, financial considerations should not be permitted to outweigh the necessity for a criterion of acceptability in the sale of advertising or exhibit space.

In the coming year, whether or not the war is over, there will probably be no important change in our economic picture so far as exhibits are concerned, and it is presumed that the trend toward higher standards will continue. How, then, can our meetings be conducted on a sound and beneficial basis? Well, those societies with bulging treasuries, if indeed there are any, can draw on their reserves to assure the continuance of their meetings on their usual basis—the rest will have to (1) impose severe economies and by so doing reduce the size and therefore the value of their scientific programs, or (2) find new sources of revenue.

It is the purpose here to advocate the second of the alternatives together with the adoption of proper economies in meeting operation. To restrict the scientific program unduly is to defeat the purpose of meetings and is destructive in its effect. Acceptance of the second alternative constitutes a challenge to management and, if assiduously pursued, can result in better and more useful meetings than were enjoyed in the "good old days."

The rest of this article will be devoted to suggestions for raising new revenue that have been found satisfactory and workable. First of all, the meeting expense budget should be set up in the usual manner and compared with a conservative estimate of income. The probable deficit will immediately be apparent and it will then be known just how much new money must be attracted. By new money, we mean, of course, revenue from other than commercial sources. However, a penny saved is a penny earned, so the first step is to examine the expense budget critically for economy possibilities.

1. *Eliminate non-essential activities.* A good idea here is to have some outsider, preferably a business man of repute, go over the budget with you. Go through the motions of justifying every item. The businessman may surprise you with some excellent recommendations that will lead to substantial savings.

2. *Wherever activities overlap, consolidate them.* An example of this is the consolidation of the registration and credentials activities. Others will be found if searched for diligently.

3. *Scale down less essential activities.*

4. *Study all purchases for eliminations and substitutions.* Printed programs can be eliminated by substituting an issue of the society's official magazine—an already common practice—or the official program can be reprinted from the official magazine for distribution to meeting visitors. The use of inexpensive paper badges with lapel attachment instead of ribbon badges will likewise effect a considerable saving.

5. *Compel all social functions to be self-sustaining.* It is frequently the practice of societies to provide at least one evening of free entertainment—a vaude-

ville show, informal dance or some similar function. The provision of free entertainment is, at least in most cases, unnecessary and can actually work to the disadvantage of meeting visitors. It might be charged that this suggestion is impractical because convention-goers will resent having to pay for something that has heretofore been free. This can be circumvented by announcing that the proceeds will be devoted to some charitable activity, such as the society's own relief fund. If the entertainment is a vaudeville performance, seats can be reserved. This always makes for better feeling because people can then arrive just before curtain time and still be assured of seats. Moreover, groups can sit together, a privilege not often possible in free entertainment where seats are assigned on a first-come, first-served basis.

6. *Add new features to the scientific program for which a justifiable charge may be made.* General sessions, lectures, exhibits and general clinics form the traditional pattern of scientific programs and practically all meetings present them. There is a comparative newcomer to the scientific program field, however, variously known as the registered or limited attendance clinic, which might well be added by any meeting management. In effect, this is a clinic presented in a small private room to not more than twenty-five persons and for which a small charge is made. If all factors are in proper proportion, a program of such clinics can actually be profitable and easily be the "hit" of the meeting. The willingness of dentists to pay for such presentations is well known and is based on the extreme attractiveness of the limited attendance clinic. Frequently, essayists already scheduled to appear on the program can be induced to give two or more clinics with no additional honorarium. Because of the income-producing factor, many societies can invite clinicians whom they would not otherwise be able financially to ask to appear on their programs.

This is by no means a complete list of all the things a dental society may do to keep its financial ship on an even keel with respect to its annual meetings. In presenting these few ideas, it is intended merely to suggest a line of thought which, if pursued, will doubtless result in many other economies and the discovery of avenues to new revenues. The end-result will be two-fold: solvent meeting operation during the emergency and better meetings both now and in the postwar period.

ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following articles in the list of Accepted Dental Remedies.

ANESTHETICS

Anesthetics—General*

Vinethene.—Vinyl Ether for Anesthesia-Merck.—Divinyl ether. $CH_2:CHOCH:CH_2$ with the addition of 3.5 per cent absolute alcohol and 0.01 per cent of phenyl-a-naphthylamine.

Caution.—*Vinethene is inflammable and deteriorates on exposure to air and light. It should not be used for anesthesia if the original container has been opened longer than twenty-four hours.*

ACTIONS AND USES.—Vinethene is an inhalation anesthetic to be used for short anesthesias. It differs from ether, U.S.P., in the rapidity of its action. This property necessitates special caution in its administration. It is easy to pass from the level of surgical anesthesia to dangerous overdosage; therefore, the importance of constant, close observation of the patient cannot be overemphasized. Properly watched, this rapid action is of advantage in short anesthesia, as is the prompt recovery that follows administration of the drug. To prevent recovery from occurring before the surgical procedure is completed, vinethene must be administered continuously during maintenance. It can be administered by the open drop, semi-open drop or closed machine method. It seems, at the present time, that the open drop method is preferable for short anesthesia. In any case, an adequate oxygen or air supply is essential and an unobstructed airway is of paramount importance.

The dentist whose experience in general anesthesia has been with nitrous oxide will need to be keenly aware of the fact that the anesthetic landmarks already known to him will be of no use in administering vinethene. It is furthermore of the utmost importance that he become thoroughly familiar with the physical and pharmacologic properties of this agent. He should see it given by an experienced anesthetist, and have able supervision during his first administrations of the drug. This will help him decidedly in mastering the difficulties caused by its high volatility and potency. An increase in volatility on hot days will increase the mechanical difficulties of administration, and high altitudes operate in the same direction. Its explosive hazard is about equivalent to that of ethyl ether. Under no circumstances should vinethene be used when liver disease or irritative conditions of the respiratory tract are known to be present. Added caution is necessary when degenerative disease or renal insufficiency exists.

Special caution should be observed with regard to the ambulatory patient. On recovering from vinethene anesthesia, the patient should be kept under observation until he appears to be completely oriented and for a period of from ten to fifteen minutes thereafter.

A detailed statement of actions and uses appears in N.N.R. A recent article by E. A. Zaus briefly summarizes the current knowledge of vinethene. (J.A.D.A., 30:439, March 1, 1943.)

Tests and standards appear in N.N.R.

*A.D.R. Ed. 9, page 33.

Manufactured by Merck & Co., Inc., Rahway, N. J.
U. S. patents 2,021,872 (Nov. 19, 1935; expires 1952); 2,044,800 (June 23, 1936; expires 1953); 2,044,801 (June 23, 1936; expires 1953); and 2,099,695 (Nov. 23, 1937; expires 1954). U. S. trademark 312,453.

Algin—Sodium Alginate.—Algin is a dried purified mucilaginous substance extracted from kelp. Chemically, it is stated to be the sodium salt of polymerized uronic acid. The word algin is not a controlled trade name.

PROPERTIES: A white to light cream-colored amorphous, odorless and tasteless powder. Its solubility in water is limited by the viscosity of the resulting solution. One gram produces a very viscous solution when dissolved in 10 cc. of water. It is insoluble in alcohol and mineral acids.

INCOMPATIBILITIES: Aqueous solutions of algin are incompatible with solutions of many mineral salts, particularly calcium chloride, aluminum sulfate, zinc chloride and barium and strontium chlorides. Aqueous solutions are also incompatible with acids, and are not stable below pH 3.0.

ACTIONS AND USES: It is used as a thickening agent in the manufacture of tooth paste.

TESTS FOR IDENTITY: Aqueous solutions of algin coagulate at pH 3.0 to form a jelly-like mass without changing color or translucency. Procedure: To 100 cc. of a 1 per cent solution of algin, add, with constant stirring, 10 cc. of 10 per cent sulfuric acid. A thick coagulum results which, on standing, splits off and can be further separated by filtration.

TESTS FOR PURITY:

Insoluble Matter: When tested in accordance with the procedure for determination of insoluble matter as described on page 645 of U.S.P. XII, 0.5 gm. of algin yields not more than 0.001 gm. of insoluble matter.

Viscosity: A solution of 0.5 gm. of algin in 100 cc. of water has a viscosity of not less than 300 centipoises and not more than 450 centipoises. Procedure: Using a MacMichael viscosimeter, fill the cup to the first graduation on the plunger rod and establish a temperature of 20° C. Speed of rotation, 22 RPM, wire No. 28.

Ash: When ashed in accordance with the procedure described on page 628 of U.S.P. XII, 5 gm. of algin yields not more than 0.8 gm. of ash.

Starch: A solution made by boiling 0.1 gm. of algin in 100 cc. of distilled water does not, upon cooling, produce a blue color upon the addition of iodine test solution, U.S.P. XII.

Gelatin: To an 0.5 per cent solution of algin, add a few drops of ammonium molydate, T.S. A white flocculent precipitate indicates the presence of gelatin. The precipitate dissolves partially on warming and reappears on cooling.

Manufactured by the Algin Corporation of America, New York, N. Y. U. S. Patent No. 2,128,551. No trademark.

Admission of a product to the list of Accepted Dental Remedies does not imply a recommendation. It means that the product and the methods by which it was marketed at the time of consideration were not found to be in violation of the Council's published rules. Accepted products are reconsidered periodically. The files of the Council contain information on many drugs and dental cosmetics. All information is available upon request and inquiries are welcomed. A postal card will bring a prompt reply.

DONALD A. WALLACE, *Secretary.*

COMMITTEE ON ECONOMICS

MEETING OF INDUSTRIAL DENTISTS

IN the September issue of THE JOURNAL, it was announced that a meeting of industrial dentists is to be held on October 26.

As was apparent from the further statement that the meeting is to be held in conjunction with the annual meeting of the American Dental Association, this date was an error. The meeting is to be held on Tuesday, October 12, at 10:00 a.m. in Parlors A and B of the Netherland Plaza, Cincinnati. All men working in the field of industrial dentistry and also those who may not be working in the field, but who are particularly interested in the subject are urged to attend this session.

At this meeting, a constitution and bylaws are to be adopted and the organization of industrial dentists established on a permanent basis. Through attending this meeting, you will have an opportunity to become a charter member of the organization and to have a part in its creation.

If you plan to attend the session, you are requested to write to the secretary of the temporary committee on industrial dentistry, R. M. Walls, 222 East Superior St., Chicago, 11, Ill.

COUNCIL ON DENTAL EDUCATION

REPORT ON GRADUATES OF DENTAL SCHOOLS IN THE UNITED STATES FOR YEAR ENDING JUNE 30, 1943

THE accompanying compilation made by the Council on Dental Education of the American Dental Association shows that there were 1,926 graduates from the thirty-nine dental schools in the United States during the academic year ending June 30, 1943. This is the largest number of graduates in one academic year since 1932-1933, when 1,986 were graduated. While the schools are now all administering accelerated schedules, the effect of the accelerated plan from the standpoint of the number graduated is not discernible in the list of graduates for the last academic year.

There were 1,946 seniors enrolled in the schools on October 15, 1942, and it would seem that nearly all of them finished their courses and graduated. The accelerated plan did operate, however, to permit many of the seniors listed in 1942 to finish their courses earlier than they had anticipated. Thus, while the normal time for graduation was May and June 1943, by reason of the accelerated plan classes were graduated as follows: December 1942, two; January 1943, two; February 1943, eleven; March 1943, thirteen; April 1943, two; May 1943, four; June 1943, four, and one school, operating in part on the accelerated plan regularly, graduated some students in September 1942, some in March 1943 and some in June 1943. The total output of graduates for the calendar year 1943 will, of course, be greatly increased by the fact that twenty-eight schools will be graduating additional

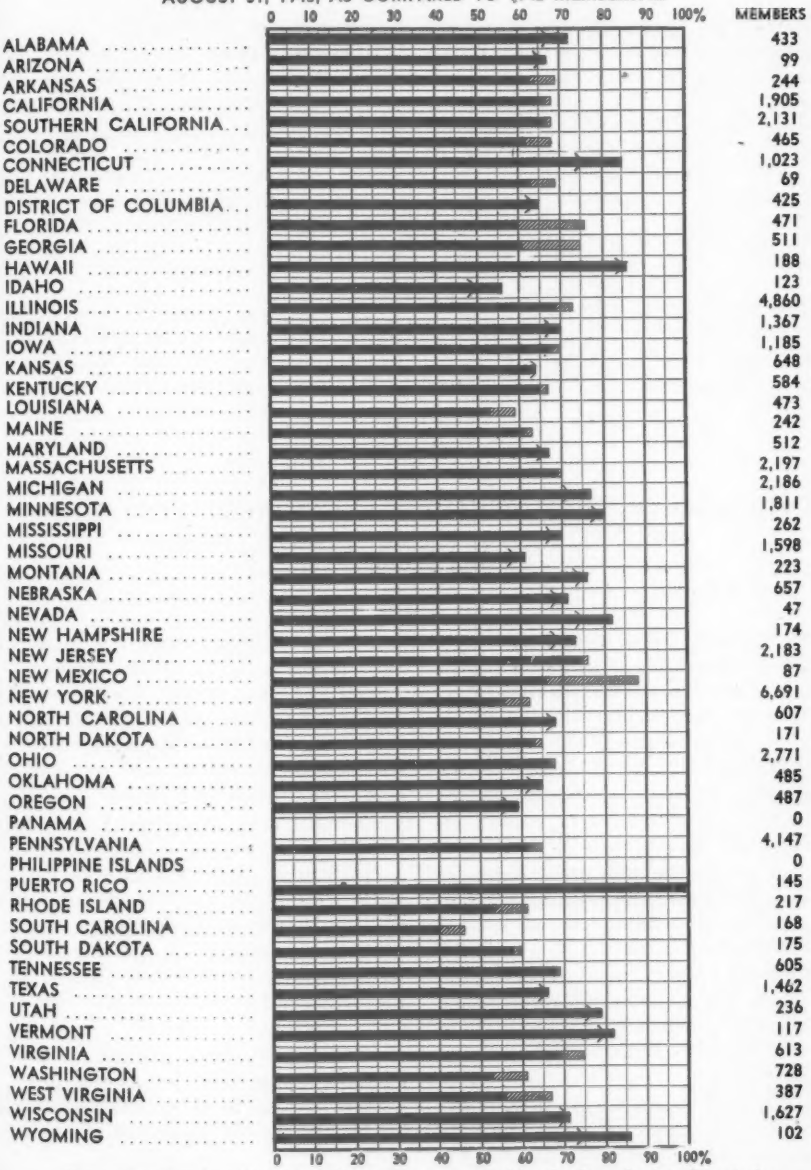
classes between July 1 and December 31. On the basis of the enrollment of juniors in October 1942, it is estimated that these twenty-eight schools will graduate about 1,600 students between July and December 1943.

GRADUATES OF DENTAL SCHOOLS IN THE UNITED STATES FOR THE YEAR ENDING JUNE 30, 1943

School	Predental College Training						Total	Per Cent with Degree	No. Graduating in Combined Courses
	Less Than Two Years	Two Years	Three Years	Four Years Without Degree	Bachelor's Degree	Other Degree			
College of P. & S.	0	22	9	0	0	1	32	3	12
U. of California	0	18	7	3	2	0	30	7	28
U. of S. California	0	48	6	5	18	0	77	23	43
Georgetown U.	0	16	8	7	12	1	44	30	0
Howard U.	0	4	2	2	10	0	18	55	0
Atlanta-Southern	0	46	11	5	13	0	75	17	0
Loyola, Chicago	2	53	6	0	7	0	68	10	0
Northwestern U.	0	43	7	0	23	3	76	34	0
U. of Illinois	0	31	16	0	7	0	54	13	38
Indiana U.	0	15	7	1	2	0	25	8	0
State U. of Iowa	0	24	9	1	8	0	42	19	13
U. of Louisville	0	15	15	8	15	0	53	28	0
Loyola, New Orleans	0	28	4	0	4	0	36	11	0
U. of Maryland	0	43	15	5	21	0	84	25	0
Harvard U.	1	16	4	0	16	0	37	43	0
Tufts Coll.	0	34	6	0	25	3	68	41	0
U. of Detroit	0	18	2	0	4	0	24	17	0
U. of Michigan	1	19	9	0	14	2	45	36	5
U. of Minnesota	0	32	15	4	8	3	62	17	0
U. of Kansas City	0	51	3	2	7	0	63	11	0
St. Louis U.	0	16	3	4	10	6	39	41	16
Washington U.	0	9	5	1	8	0	23	35	1
Creighton U.	0	21	0	1	3	0	25	12	6
U. of Nebraska	1	9	1	0	3	0	14	21	8
Columbia U.	0	0	15	0	37	1	53	72	2
New York U.	0	7	50	3	74	1	135	56	21
U. of Buffalo	0	21	8	0	10	0	39	26	0
Ohio State U.	0	28	14	2	20	1	65	32	2
Western Reserve U.	0	15	13	4	10	0	42	24	15
N. Pacific Coll.	0	28	3	0	17	0	48	35	0
Temple U.	0	67	5	0	22	0	94	23	0
U. of Pennsylvania	0	33	10	3	36	0	82	44	0
U. of Pittsburgh	0	38	13	0	17	5	73	30	7
Meharry Med. Coll.	0	2	0	0	6	0	8	75	0
U. of Tennessee	0	18	0	0	7	1	26	30	0
Baylor U.	0	32	2	0	5	0	39	13	5
Texas Dent. Coll.	0	15	2	2	3	2	24	21	0
Med. Coll. of Virginia	0	10	8	0	7	0	25	28	4
Marquette U.	0	35	9	0	15	0	59	25	5
Totals	5	980	322	63	526	30	1,926	29	231

Membership Page

PERCENTAGE OF DUES RECEIVED IN CENTRAL OFFICE AS OF AUGUST 31, 1943, AS COMPARED TO 1942 MEMBERSHIP



Percentage based on dental population figures supplied by the State Society Secretaries.

1943 percentage 1942 percentage

NATIONAL BOARD OF DENTAL EXAMINERS

FOLLOWING is the name of a successful candidate in Part 2 of the National Board Examinations, May 3-4, 1943:

Northwestern University
Ray M. Taylor

GORDON L. TEALL, *Secretary.*

PAN AMERICAN COMMITTEE

THE newly elected officers of the American Dental Society of the Argentine Republic are: president, George French; vice president: M. V. Tidball; secretary: R. Blanco; treasurer: Charles M. Smart; editor: H. L. Prettyman; executive committee: Carlos Valenzuela, Julio Gardia and Jose O'Farrell.

CHICAGO DENTAL SOCIETY ANNOUNCES ITS THIRD ANNUAL PRIZE ESSAY COMPETITION

As its contribution to the encouragement of research and investigation in dentistry, the Chicago Dental Society announces a nation-wide competition for the best essay containing new and significant material of value to dentistry. One cash prize of $500 is offered and the recipient will be invited to present his essay at the 1944 Midwinter Meeting to be held at the Palmer House February 21-24. The expense of attendance will be borne by the Chicago Dental Society and will be in addition to the cash prize of $500.

"Many excellent papers were entered in our two previous competitions," said Leo W. Kremer, president of the Chicago Dental Society, "and we have every reason to believe that despite present war conditions our third effort will be even more successful. As the rules printed below clearly indicate, this is not a closed competition solely for research men having large technical staffs and elaborate equipment at their disposal. This contest is open to every qualified person who believes he has something new and important to contribute to dentistry."

Eligibility: Any American Dental Association member or other person of scientific attainment affiliated with a recognized institution in the dental field shall be eligible to apply for permission to enter the competition, provided written application is filed before October 15. The Chicago Dental Society, through its duly appointed committee, shall pass upon the qualifications of applicants. Application forms may be secured upon written request to the Chicago Dental Society, 30 N. Michigan Ave., Chicago, 2, Ill.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

AMERICAN ASSOCIATION OF DENTAL EDITORS, Cincinnati, Ohio, October 12.

AMERICAN ASSOCIATION OF PUBLIC HEALTH DENTISTS, Cincinnati, Ohio, October 10.

AMERICAN COLLEGE OF DENTISTS, Cincinnati, Ohio, October 14.

AMERICAN DENTAL ASSISTANTS ASSOCIATION, Cincinnati, Ohio, October 11-14.

AMERICAN DENTAL ASSOCIATION, House of Delegates, Cincinnati, Ohio, October 11-13.

AMERICAN DENTAL HYGIENISTS' ASSOCIATION, Cincinnati, Ohio, October 10-13.

AMERICAN SOCIETY FOR THE ADVANCEMENT OF GENERAL ANESTHESIA IN DENTISTRY, New York, N. Y., October 25.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS, Cincinnati, Ohio, October 8-9.

UNIVERSITY OF BUFFALO DENTAL ALUMNI ASSOCIATION, Buffalo, N. Y., October 19-21.

DISTRICT OF COLUMBIA DENTAL SOCIETY, second and fourth Tuesdays in each month, from October to June, at the United States Public Health Service Auditorium, Washington.

INDUSTRIAL DENTISTS, Cincinnati, Ohio, October 12.

MONTREAL (CANADA) DENTAL CLUB, October 20-22.

NATIONAL ASSOCIATION OF DENTAL EXAMINERS, Cincinnati, Ohio, October 9-10.

NATIONAL BOARD OF DENTAL EXAMINERS, October 25-26; January 24-25, 1944; May 1-2, 1944.

GREATER NEW YORK DENTAL MEETING, New York, December 6-10.

NEW YORK SOCIETY OF ORTHODONTISTS, New York, November 8-9.

WOMEN'S DENTAL SOCIETY OF NEW YORK, New York, October 20.

PAST PRESIDENTS' CLUB, Cincinnati, Ohio, October 12.

GREATER ANNUAL MEETING, UNIVERSITY OF PENNSYLVANIA, JUNIOR AMERICAN DENTAL ASSOCIATION, Philadelphia, October 28.

GREATER PHILDELPHIA ANNUAL MEETING, February 2-4, 1944.

ROOT CANAL THERAPY ORGANIZATION, Chicago, February 1944.

STATE SOCIETY OFFICERS' CONFERENCE, Cincinnati, Ohio, October 10.

STATE SOCIETIES

November

Florida, at Jacksonville (10-11)

Ohio, at Cleveland (7-10)

Tennessee, at Nashville (21-24)

January 1944

Rhode Island, at Providence

March 1944

Minnesota, at St. Paul (1-3)

Wisconsin, at Milwaukee (20-22)

April 1944

Virginia, at Richmond (3-5)

STATE BOARDS OF DENTAL EXAMINERS

Alabama, at Birmingham, November 29 Farrar McCrummen, 1006 Woodward Bldg., Birmingham, Secretary.

California, at San Francisco, October 25 and at Los Angeles, November 29. Kenneth I. Nesbitt, 515 Van Ness Ave., San Francisco, Secretary.

Connecticut, at Hartford, December 7-11. Clarence G. Brooks, 302 State St., New London, Recorder.

Florida, at Jacksonville, November 29-December 2. L. D. Pankey, 138 Alhambra Circle, Coral Gables, Secretary.

Kentucky, at Louisville, November 16-19. W. F. Waltz, 1114 First Nat'l Bank Bldg., Lexington, Secretary.

Minnesota, at Minneapolis, December 13-18. G. R. Metcalf, Barnesville, Secretary.

New Jersey, January 10-15, 1944. J. F. Burke, 150 E. State St., Trenton, Secretary.

North Carolina, at Raleigh, December 27. Wilbur Jackson, Rich Bldg., Clinton.

Ohio, at Cleveland, October 18-20; at Columbus, November 29-December 1. Earl D. Lowry, 79 E. State St., Columbus, Secretary.

Pennsylvania, at Philadelphia and Pittsburgh, October 19-23. Reuben E. V. Miller, 61 N. Third St., Easton, Secretary.

Tennessee, at Memphis, December 12-16. W. W. Martin, 115 W. Jefferson, Pulaski, Secretary.

Wisconsin, at Milwaukee, November 8-12. S. F. Donovan, Tomah, Secretary.

AMERICAN ASSOCIATION OF DENTAL EDITORS

THE American Association of Dental Editors will hold a luncheon meeting in the Netherland Plaza, Cincinnati, Ohio, Tuesday, October 12. Members are urged to be present.

O. W. BRANDHORST, *Secretary,*
4952 Maryland Ave.,
St. Louis, Mo.

AMERICAN ASSOCIATION OF PUBLIC HEALTH DENTISTS

THE American Association of Public Health Dentists will hold its annual meeting in Cincinnati, Ohio, October 10, at the Netherland Plaza.

FRANK C. CADY, *Secretary,*
USPHS Hospital,
Lexington, Ky.

AMERICAN COLLEGE OF DENTISTS

THE Board of Regents of the American College of Dentists will meet with the representatives of the sections, Thursday morning, October 14 at 9 o'clock, in the Netherland Plaza, Cincinnati, Ohio. Fellows attending the A.D.A. House of Delegates meeting are invited to attend.

O. W. BRANDHORST, *Secretary,*
4952 Maryland Ave.,
St. Louis, Mo.

AMERICAN DENTAL ASSISTANTS ASSOCIATION

THE nineteenth annual session of the American Dental Assistants Association will be held in Cincinnati, Ohio, October 11-14, with headquarters at the Hotel Gibson.

AILEEN M. FERGUSON,
General Secretary,
709 Centre St.,
Jamaica Plain, Mass.

AMERICAN DENTAL ASSOCIATION MEETING OF THE HOUSE OF DELEGATES

THE opening session of the House of Delegates will convene at 10 a.m., Monday, October 11. The second session will be held at 2 p.m., Monday, October 11. The third session will be held at 2 p.m., Tuesday, October 12. The fourth session will be held at 1 p. m., Wednesday, October 13. The four sessions will be held in the Hall of Mirrors of the Netherland Plaza.

The Credentials Committee will register Delegates and Alternates beginning at 10 a.m., Sunday, October 10, on the third floor, Netherland Plaza. Reservations must be made with the hotel.

AMERICAN DENTAL HYGIENISTS' ASSOCIATION

THERE will be a special meeting of the House of Delegates and the Board of Trustees of the American Dental Hygienists' Association in Cincinnati, Ohio, October 10-13. Headquarters will be at the Hotel Gibson.

A REBEKAH FISK, *Secretary,*
Arlington, Va.

AMERICAN SOCIETY FOR THE ADVANCEMENT OF GENERAL ANESTHESIA IN DENTISTRY

THE fall meeting of the American Society for the Advancement of General Anesthesia in Dentistry will be held October 25 at the National Republican Club, with a dinner at 7 p.m. and scientific session at 8:15. James R. Cameron, president, of Philadelphia, will preside. The speaker will be Julia Arrowwood, director of anesthesia at the Massachusetts General Hospital, Boston, who will speak on "General Anesthesia in Dental and Oral Surgery." Dr. Arrowwood will also describe two separate pieces of research that she has been engaged in at the hospital. The members of the profession are invited.

M. HILLEL FELDMAN, *Secretary,*
730 Fifth Ave.,
New York, N. Y.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS

THE twenty-fifth annual meeting of the American Society of Oral Surgeons and

Exodontists will be held at the Netherland Plaza, Cincinnati, Ohio, October 8-9.

HARRY BEAR, *Secretary,*
410 Professional Bldg.,
Richmond, Va.

UNIVERSITY OF BUFFALO DENTAL ALUMNI ASSOCIATION

THE forty-second annual meeting of the University of Buffalo Dental Alumni Association will be held October 19-21, at the Hotel Statler, Buffalo, N. Y. The Eighth District Dental Society of the State of New York is cooperating. All ethical practitioners are invited to attend.

JOHN D. LYNCH, *Chairman of Publicity,*
University of Buffalo,
School of Dentistry,
Buffalo.

MONTREAL DENTAL CLUB FALL CLINIC

THE Nineteenth Annual Fall Clinic under the auspices of the Montreal Dental Club will be held at the Mount Royal Hotel, Montreal, Canada, October 20-22. For further information, apply to

M. L. DONIGAN, *Director,*
Drummond Medical Bldg.,
Montreal.

NATIONAL ASSOCIATION OF DENTAL EXAMINERS

THE National Association of Dental Examiners will hold its next annual meeting October 9-10, in the Netherland Plaza, Cincinnati, Ohio.

R. P. THOMAS, *Secretary,*
Francis Bldg.,
Louisville, Ky.

NATIONAL BOARD OF DENTAL EXAMINERS

THE following are the dates for the next examinations of the National Board of Dental Examiners: October 25-26; January 24-25, 1944; May 1-2, 1944. The dates of the 1944 examinations are subject to change after the executive committee meeting of the Board in Cincinnati in October. Applications should be sent through deans.

GORDON L. TEALL, *Secretary.*

GREATER NEW YORK DENTAL MEETING

THE next Greater New York Dental Meeting will be held in the Hotel Pennsylvania, New York, December 6-10.

S. A. ISAACSON, *Chairman,*
Press and Publication Committee,
Room 106A,
Hotel Pennsylvania,
New York.

NEW YORK SOCIETY OF ORTHODONTISTS

THE fall meeting of the New York Society of Orthodontists will be held at the Hotel Waldorf-Astoria, New York, November 8-9.

NORMAN L. HILLYER, *Secretary,*
Professional Bldg.,
Hempstead, N. Y.

WOMEN'S DENTAL SOCIETY OF NEW YORK

THE Women's Dental Society of New York will hold its next meeting at the Hotel Pennsylvania, October 20, at 8 p.m. A premeeting dinner at 6:30 will honor the speaker of the evening.

MARGARET REISS, *Publicity Chairman,*
102-50 187th St.,
Hollis.

PAST PRESIDENTS' LUNCHEON

THE Past Presidents' Club of the American Dental Association will hold its annual luncheon at 12:30, October 12, at the Netherland Plaza, Cincinnati, Ohio. The annual address will be delivered by G. Walter Dittmar, with Arthur H. Merritt presiding.

HOMER C. BROWN, *Secretary,*
1816 Franklin Ave.,
Columbus, Ohio.

GREATER ANNUAL MEETING OF THE UNIVERSITY OF PENNSYLVANIA JUNIOR AMERICAN DENTAL ASSOCIATION

THE Greater Annual Meeting of the University of Pennsylvania Junior American Dental Association will be held October 28 from 9 to 11 p.m. at the Thomas W. Evans Museum and Dental Institute, School of Dentistry. The program is as follows: 9 a.m.: Earle B. Hoyt: Fixed Denture Prosthesis. 10:30 a.m.: Elvin F. Axt: Surgical Prosthesis. 11 a.m.: Student activities and table clinics: (1) oral surgery, exodontia and anesthesia; (2) oral medicine, oral pathology and bacteriology; (3) prosthetics (full and partial dentures); (4) operative and children's dentistry. 12:30 p.m.: Lunch. 2 p.m.: Douglas

B. Parker: Oral Surgical Aspects of the Present War. 3:30 p.m.: Table clinics: (1) Harry C. Best: Amalgam Restorations. (2) Jacob A. Eberly, Jr.: Silicate Restorations. (3) Herbert Fischer: Electrical Coagulation. (4) Victor H. Frank: Exodontia. (5) John H. Greene: Periodontia. (6) Howard K. Matthews: Gold Inlay Restorations. (7) Winifield W. Powell: Ceramics. (8) John W. Ross: Practical Orthodontia. 8 p.m.: Buffet dinner at the Benjamin Franklin Hotel.

GREATER PHILADELPHIA ANNUAL MEETING

THE Greater Philadelphia Annual Meeting will be held February 2-4, 1944 at the Benjamin Franklin Hotel.

JOHN P. LOOBY, *Chairman,*
Publicity Committee.

ROOT CANAL THERAPY ORGANIZATION

AT the Midwinter Meeting of the Chicago Dental Society, a national group for the study of root canal therapy was organized. W. Clyde Davis was made president, and John H. Hospers, secretary-treasurer. Committees were appointed to draw up a constitution and to select a name, to be submitted at the next regular meeting, in Chicago in February 1944. It is hoped that all those who are interested in this fundamental phase of dentistry will associate themselves with the group. Those joining before the final organization will be considered charter members. Annual dues were temporarily set at $2. All correspondence should be addressed to

JOHN H. HOSPERS, *Secretary,*
25 E. Washington St.,
Chicago, Ill.

STATE SOCIETY OFFICERS' CONFERENCE

THE annual conference of State Society Officers will be held Sunday, October 10, at the Netherland Plaza, Cincinnati, Ohio. All State Society Officers are invited to attend.

C. S. FOSTER, *Secretary.*

FLORIDA STATE DENTAL SOCIETY

THE Florida State Dental Society will hold its next annual meeting November 10-11 at the George Washington Hotel, Jacksonville.

HORACE L. CARTEE, *Secretary,*
Huntington Building,
Miami.

MINNESOTA STATE DENTAL ASSOCIATION

THE sixty-first annual session of the Minnesota State Dental Association will be held in the Municipal Auditorium, St. Paul, March 1-3, 1944. All members of the American Dental Association are invited to attend.

L. M. CRUTTENDEN, *Secretary,*
498 Lowry Bldg.,
St. Paul.

OHIO STATE DENTAL SOCIETY

THE next annual meeting of the Ohio State Dental Society will be held in Cleveland, November 7-10.

EDWARD C. MILLS, *Secretary,*
255 E. Broad St.,
Columbus.

RHODE ISLAND STATE DENTAL SOCIETY

THE next meeting of the Rhode Island State Dental Society will be held in Providence in January 1944.

CHARLES F. MCKIVERGAN,
Secretary Pro Tem.,
102 Waterman St.,
Providence.

TENNESSEE STATE DENTAL ASSOCIATION

THE Tennessee State Dental Association will hold its sixty-sixth annual meeting in Nashville, November 21-24, at the Hotel Andrew Jackson.

E. JEFF JUSTIS, *Secretary,*
Exchange Bldg.,
Memphis.

ALABAMA BOARD OF DENTAL EXAMINERS

THE next examination of the Alabama Board of Dental Examiners will be held November 29 in Birmingham. Credentials and fees must be in the hands of the secretary two weeks in advance of the examina-

tion. For application forms and further information, address

FARRAR MCCRUMMEN, *Secretary,*
1006 Woodward Bldg.,
Birmingham.

BOARD OF DENTAL EXAMINERS OF CALIFORNIA

THE next examinations to be conducted by the Board of Dental Examiners of California for licensure in the State of California will be held in San Francisco commencing October 25 and in Los Angeles commencing November 29. All credentials must be in the office of the secretary, Room 203, 515 Van Ness Ave., San Francisco, at least twenty days prior to the examinations. Address all communications to

KENNETH I. NESBITT, *Secretary.*

CONNECTICUT DENTAL COMMISSION

THE Connecticut Dental Commission will meet in Hartford, December 7-11, for examination of applicants for license to practice dentistry and dental hygiene and to transact any other business proper to come before it. Applications should be in the hands of the recorder at least ten days before the meeting. For application blanks and further information, apply to

CLARENCE G. BROOKS, *Recorder,*
302 State St.,
New London.

FLORIDA STATE BOARD OF DENTAL EXAMINERS

THE Florida State Board of Dental Examiners will hold its annual examination of applicants for license to practice dentistry or dental hygiene in Florida at Jacksonville in the Seminole Hotel, November 29-December 2. Candidates for dental licenses must file preliminary applications by September 28. Final applications for dentists and dental hygienists must be complete by October 28. Address all communications to

L. D. PANKEY, *Secretary,*
138 Alhambra Circle,
Coral Gables.

KENTUCKY STATE BOARD OF DENTAL EXAMINERS

THE next meeting of the Kentucky State Board of Dental Examiners will be held November 16-19, at the University of Louisville Dental School, Louisville. Dentists having graduated prior to 1943 and desiring to stand examination before this board must file applications, complete with full information requested, at this office not later than September 16. Applications of 1943 graduates must be in the secretary's office by October 16. Dental hygienists having completed a two year hygienist course and desiring to stand examination before this board must file applications by October 16. Ample time should be allowed for securing all data required. For application forms and further information, address

W. F. WALZ, *Secretary,*
1114 First Nat'l Bank Bldg.,
Lexington.

MINNESOTA STATE BOARD OF DENTAL EXAMINERS

THE next examination of the Minnesota State Board of Dental Examiners will be held at the College of Dentistry, University of Minnesota, Minneapolis, December 13-18. All examination fees must be in the hands of the secretary at least ten days before the date of the examination. Address all communications to

G. R. METCALF, *Secretary,*
Barnesville.

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

THE next meeting of the North Carolina State Board of Dental Examiners for the examination of applicants for licensure will be held at the State Capitol, Raleigh, beginning December 27. Applications must be filed with the secretary thirty days before the examination. For application blanks and further information, address

WILBUR JACKSON, *Secretary,*
Rich Bldg.,
Clinton.

OHIO STATE DENTAL BOARD

THE practical examination of the Ohio State Dental Board will be held at Western Reserve University School of Dentistry, Cleveland, October 18-20, and at Ohio State University College of Dentistry, Columbus, November 29-December 1. The practical examination may be taken either in Cleveland or in Columbus, provided due notice is given to the secretary. The theory examination will be held in Columbus, December 2-4. All applications must be in the hands of the secretary at least ten days before

the examination. For further information, apply to

EARL D. LOWRY, *Secretary,*
79 E. State St.,
Columbus.

DENTAL COUNCIL AND EXAMINING BOARD OF THE COMMONWEALTH OF PENNSYLVANIA

THE Dental Council and Examining Board of the Commonwealth of Pennsylvania will meet in Philadelphia and Pittsburgh, October 19-23, to examine applicants for licensure to practice dentistry. For further information and application blanks, address the Department of Public Instruction, Bureau of Professional Licensing, Dental Division, Harrisburg.

REUBEN E. V. MILLER, *Secretary,*
61 N. Third St.,
Easton.

TENNESSEE BOARD OF DENTAL EXAMINERS

THE Tennessee State Board of Dental Examiners will hold its next examination for applicants for license to practice dentistry or dental hygiene in Tennessee at the College of Dentistry, University of Tennessee, Memphis, December 12-16. All applications must be completed by November 12. Address all communications to

W. W. MARTIN, *Secretary,*
115 W. Jefferson,
Pulaski.

WISCONSIN STATE BOARD OF DENTAL EXAMINERS

THE Wisconsin State Board of Dental Examiners will conduct its next examination November 8-12, at Marquette University College of Dentistry, Milwaukee. For further information, address

S. F. DONOVAN, *Secretary,*
Tomah.

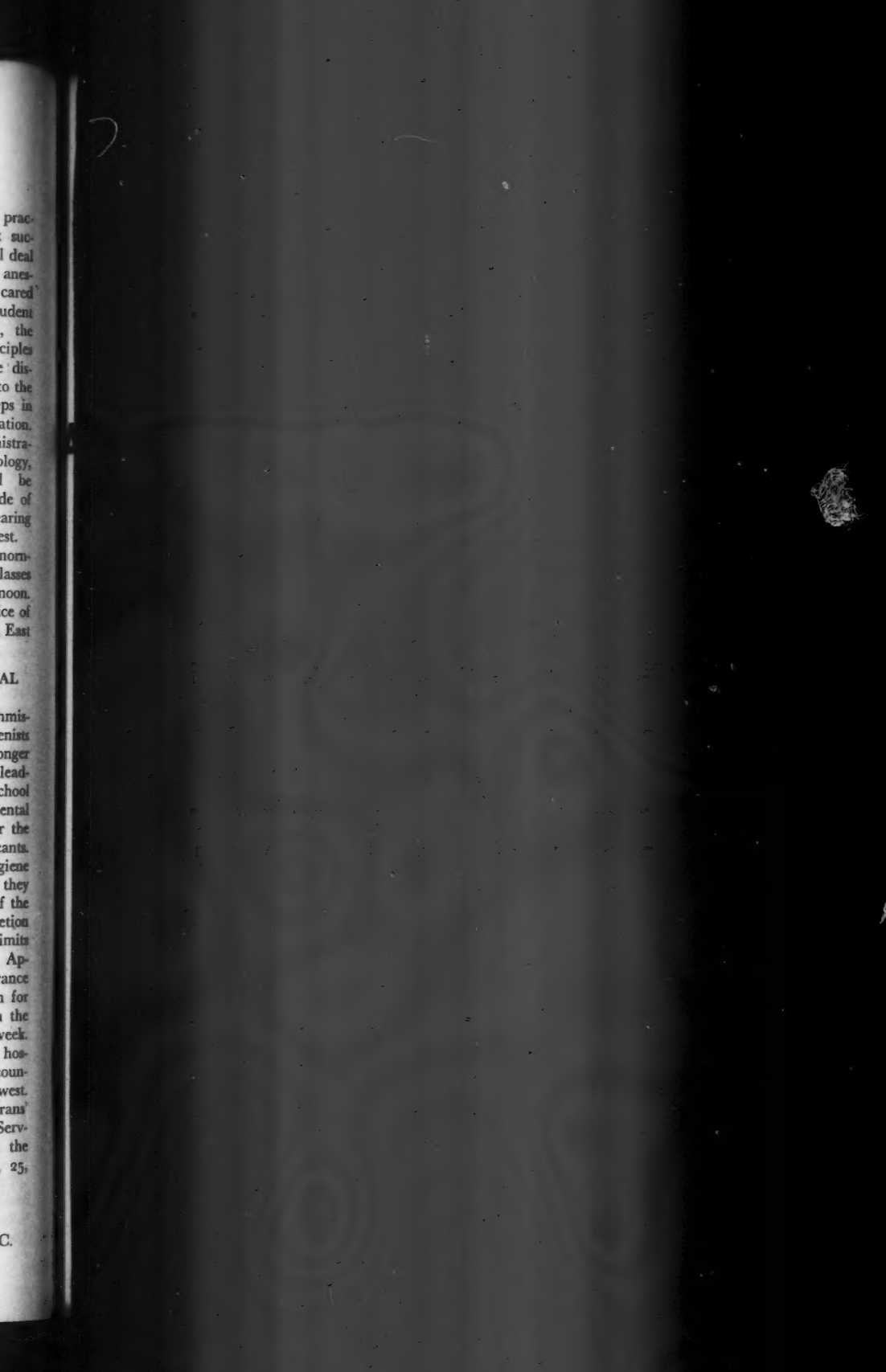
NEW YORK UNIVERSITY COLLEGE OF DENTISTRY POSTGRADUATE COURSE

New York University College of Dentistry announces a postgraduate course in inhalation anesthesia, with special emphasis on nitrous oxide-oxygen anesthesia, conducted by E. A. Rovenstine, professor of anesthesia, N. Y. U. College of Medicine and Bellevue Hospital, and A. S. Mecca, assistant professor of oral surgery, N. Y. U. College of Dentistry and Bellevue Hospital. The course, consisting of lectures and practical demonstrations conducted in six successive three-hour morning sessions, will deal with the theory and practice of general anesthesia in ambulatory cases, and patients cared for in private practice. To give the student a sound foundation and background, the mechanics of anesthesia and the principles and technic of administration will be discussed. Special attention will be given to the examination of the patient, proper steps in positioning and principles of administration. With respect to the technic of administration, the cardinal points in symptomatology, complications and emergencies will be stressed. A detailed study will be made of postoperative observation of patients, bearing directly on psychologic principles and rest.

The course will be given on Friday mornings, October 22 to November 26. Classes will begin at 9 a.m. and continue to 12 noon.

Direct all communications to the Office of the Dean, N. Y. U. Dental College, 209 East 23rd St., New York, N. Y.

FEDERAL POSITIONS FOR DENTAL HYGIENISTS

THE United States Civil Service Commission is continuing to recruit dental hygienists for federal positions. Experience is no longer necessary. Completion of a full course leading to graduation from a recognized school of oral hygiene and registration as a dental or oral hygienist in a state, territory or the District of Columbia will qualify applicants. Students enrolled in schools of oral hygiene may apply for federal positions when they are within nine months of completion of the course and may enter on duty on completion and registration. There are no age limits for the positions and no written tests. Appointees receive $1,970 a year entrance salary, which incorporates compensation for the eight hours of overtime included in the present forty-eight hour federal work week. The majority of positions are in Army hospitals and dispensaries throughout the country, particularly in the West and Southwest. Vacancies may occur also in the Veterans' Administration and the Public Health Service. Applications should be filed with the Civil Service Commission, Washington, 25, D. C.

W. C. HULL, *Executive Assistant,*
United States Civil Service Commission,
Washington, D. C.